CENTRAL VALLEY REGIONAL
WATER QUALITY CONTROL BOARD

Amendments to The Water Quality Control Plan for the Sacramento River and San Joaquin River Basins For The Control of Methylmercury in The Sacramento-San Joaquin Delta Estuary

Staff Report

Draft Report for
Scientific Peer Review

June 2006

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS FOR THE CONTROL OF METHYLMERCURY AND TOTAL MERCURY IN THE SACRAMENTO-SAN JOAQUIN DELTA ESTUARY

Draft Report for Scientific Peer Review

EXECUTIVE SUMMARY

This Central Valley Regional Water Quality Control Board (Central Valley Water Board) staff report describes a proposal to amend the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins to address the regulation of methylmercury and total mercury in the Sacramento-San Joaquin Delta Estuary (the Delta). Central Valley Water Board staff will circulate this staff report and the enclosed draft Basin Plan amendments for public review and comment prior to Central Valley Water Board consideration. The section following the Table of Contents provides the recommended format for comment submittal.

Major components of the proposed amendments are:

- Addition of a beneficial use designation of commercial and/or sport fishing (COMM) for the Delta;
- Numeric objectives for methylmercury in fish tissue that are specific to the Delta;
- An implementation plan for controlling methylmercury and total mercury sources; and
- A surveillance and monitoring program.

The Delta is on the Clean Water Act Section 303(d) List of Impaired Water Bodies because of elevated levels of mercury in fish. The goal of the proposed Basin Plan amendments (next section) is to lower fish mercury levels in the Delta so that the beneficial uses of fishing and wildlife habitat are attained.

Proposed Modifications to Basin Plan Chapter II (Existing and Potential Beneficial Uses)

Staff proposes the addition of the commercial and sport fishing (COMM) beneficial use for the Delta. Sport and commercial fishing is an existing beneficial use in the Delta.

Proposed Modifications to Basin Plan Chapter III (Water Quality Objectives)

Staff proposes numeric objectives for methylmercury in fish tissue for the Delta. Methylmercury is the most toxic form of mercury and accumulates in successive levels of the food chain. It is a neurotoxicant that adversely affects reproductive and immune systems in humans and wildlife that consume fish. Nearly all methylmercury is acquired through consumption of mercury contaminated fish and shellfish.

Staff considered five alternatives for the methylmercury numeric objectives, including no action and a range of fish tissue objectives that are based on varying fish consumption rates and fish trophic levels. The recommended alternative would establish Delta-specific methylmercury objectives of 0.24 and 0.08 mg/kg, wet weight, in fish tissue for large trophic level 4 and 3 fish (legal size if designated by the California Department of Fish and Game, otherwise 150-500 mm total length) and 0.03 mg/kg, wet

weight, for small trophic level 2 and 3 fish (less than 50 mm). This alternative allows people to safely eat 32 g/day (one meal per week) of trophic level 3 and 4 fish from the Delta along with a moderate amount of commercial fish. The 32 g/day consumption rate is consistent with the consumption rate that staff of the San Francisco Bay Regional Water Quality Control Board (San Francisco Bay Water Board) is recommending for a methylmercury objective for San Francisco Bay. The proposed objectives are protective of threatened and endangered species that consume large and small Delta fish.

Proposed Modifications to Basin Plan Chapter IV (Implementation)

To achieve the proposed water quality objectives, staff proposes the addition of an implementation plan with actions and time schedules to reduce methyl and total mercury sources to the Delta. The strategy includes methylmercury allocations based on an aqueous methylmercury implementation goal that is linked to the proposed fish tissue objectives. Available information indicates that achieving an annual average methylmercury (unfiltered) concentration of 0.06 ng/l in Delta waters would enable attainment of the proposed Delta fish tissue objectives. In addition, the strategy includes total mercury limits designed to achieve the five-year average annual total mercury load decrease of 110 kg/yr required by the San Francisco Bay mercury control program developed by the San Francisco Bay Water Board.

Sources of methylmercury in Delta waters include tributary inputs from upstream watersheds and within-Delta sources such as sediment flux from wetlands and open water habitats, municipal and industrial wastewater, agricultural drainage, urban runoff and atmospheric deposition. Available information indicates that about 60% of methylmercury loading to the Delta comes from tributary inputs and about 40% comes from within-Delta sources. Sediment flux from wetland and open water habitats in the Delta may account for most of the within-Delta annual loading with contributions of about 31% of annual loading, and wastewater treatment plants and agricultural runoff may account for about 4% and 3%, respectively. Separate methylmercury allocation systems are required for the different hydrologic areas of the Delta because fish mercury impairment and the type and amount of the methylmercury inputs to each area are substantially different. For example, wetland habitat within the Yolo Bypass subarea may contribute almost as much methylmercury to the subarea as its tributaries, compared to the Sacramento and San Joaquin subareas, which receive substantially more annual methylmercury loading from their tributaries.

In contrast to the proportion of within-Delta/tributary methylmercury inputs, more than 96% of total mercury loading to the Delta comes from tributary inputs. Sources of total mercury identified in the Delta include atmospheric deposition, urban runoff, dredging activities, and municipal and industrial wastewater. Sources of total mercury in the Delta's tributary watersheds include gold and mercury mine sites, legacy mercury in the stream channel sediments, geothermal springs, atmospheric deposition, urban runoff, and municipal and industrial wastewater.

An almost infinite number of implementation alternatives are possible for reducing the variety of methyl and total mercury sources. For this draft report, Staff identified eleven considerations that could substantially guide the implementation program, evaluated a variety of options for each consideration, formulated four alternatives based on those options, and analyzed the alternatives against evaluation criteria to select a preferred alternative. Staff recommends the adoption of an implementation plan based on the preferred alternative, which considers technical and economic feasibility and jurisdictional constraints. The preferred alternative has the following components:

- Incorporate **methylmercury allocations** for methylmercury point and nonpoint sources in the Delta and within 30 miles upstream of the Delta. Methylmercury allocations are used as guidance for methylmercury characterization and control studies.
- Incorporate a mercury characterization and control study period as **Phase 1** (2007-2014) of the implementation program.
- Characterize and limit existing methylmercury inputs that result from flood conveyance, maintenance of salinity standards and other water management practices; require mitigation for impacts caused by future changes to flood conveyance and other water management practices; and recommend actions for the agencies responsible for water management.
- New methylmercury sources that begin discharge between the amendment adoption date and 2014 would be considered in compliance with the Delta mercury control program if their responsible parties participate in the source characterization and control studies and submit a methylmercury control plan to the Central Valley Water Board at the completion of the studies. Depending on the magnitude of new sources that begin discharging before 2014, methylmercury allocations may need to be adjusted to accommodate any resulting increase in ambient methylmercury concentrations.
- By 2014, staff reviews study results, methylmercury control options, and methylmercury allocations, revises the TMDL, and recommends changes to the methylmercury control program. The Central Valley Water Board considers a Basin Plan amendment for an updated methylmercury control program.
- For **Phase 2** of the methylmercury control program (after 2014), responsible parties implement approved methylmercury control actions based on the results from the Phase 1 study period and ongoing CalFed studies. Full compliance with the methylmercury allocations is required by 2029, or sooner if required by Regional Board adopted implementation schedules.
- Include a conditional prohibition of methylmercury discharge after 2014.
- Require that methylmercury concentrations in the Delta's ambient waters not increase as a result of new or expanded projects initiated after 2014. Return waters from new agricultural areas or wetland or other habitat restoration projects would require mitigation for that portion of their loading that increases their methylmercury concentration above their source water methylmercury concentration. Other new sources discharging methylmercury concentrations less than the implementation goal (0.06 ng/l methylmercury) would be allowed to contribute methylmercury loading to the Delta. However, new sources with discharge methylmercury concentrations greater than the implementation goal would need to mitigate that portion of their load that increases their discharge concentrations above the implementation goal.
- Incorporate **total mercury limits** for point sources in the Delta and its tributary watersheds downstream of major dams, and reduction actions for tributary watersheds that export the most mercury-contaminated sediment to the Delta to reduce overall total mercury loading to the Delta by 110 kg/yr.
- Require that total mercury loading to the Delta not increase as a result of new or expanded projects. Any increase in total mercury loading would need to be mitigated or in compliance with an offset program. In the absence of an approved offset program, the Central Valley Water Board Executive Officer would evaluate new projects on an individual basis when establishing total mercury load limits in permits.

- Develop an **offset program** for total mercury based on currently available information for Central Valley Water Board consideration in 2009. Develop a methylmercury offset program in 2014, so that the program can be guided by results available from the proposed methylmercury characterization and control studies.
- Incorporate an **expanded public education and outreach program** that coordinates efforts between public agencies, dischargers and other stakeholders.

The above bulleted text describes the strategy for achieving the proposed water quality objectives. Staff divided the implementation program into two phases. The proposed Basin Plan amendments identify the actions to be taken during Phase I of the implementation program. Phase I actions and responsible parties are highlighted below.

Characterization and Control Studies. Parties responsible for maintaining or reducing methylmercury inputs to the Delta or within 30 miles upstream of the Delta are required to evaluate methyl and total mercury concentrations and loads in source and receiving waters and discharges, identify variables that control methylmercury production, and propose management practices and implementation schedules to reduce methylmercury loads and concentrations by December 2012. Parties responsible for characterization and control studies include:

- NPDES-permitted wastewater treatment plants (WWTPs) that discharge greater than one million gallons per day (mgd) and Phase I municipal separate storm sewer systems;
- Entities responsible for Cache Creek Settling Basin operations and maintenance, salinity control in the Delta, Yolo Bypass flood conveyance, and other water management activities (e.g., the South Delta Improvement Project or new or expanded reservoirs); and
- Agricultural and wetland landowners and management agencies.

Responsible parties within each source category may develop either individual or collaborative studies. The State Water Board is requested to fund or conduct studies to develop and evaluate management practices to reduce methylmercury discharges from nonpoint sources.

Conditional Prohibition of Methylmercury Discharge after 2014. The discharge of methylmercury into the Delta or its tributaries within 30 miles of the legal Delta boundary would be conditionally prohibited after 31 December 2014, unless (1) the fish tissue mercury objectives for the Delta are being met, (2) methylmercury allocations have been met, (3) the methylmercury discharge concentration is less than 0.06 ng/l (or, for agricultural and wetland discharges, less than source water methylmercury concentration), or (4) responsible parties have conducted characterization and control studies by December 2012 and implemented control actions in accordance with Central Valley Water Board adopted plans and schedules.

Total Mercury Control Actions. Responsible parties within three source categories may be required to begin implementing total mercury source control actions during Phase I of the implementation program:

- Total mercury limits based on 2008 loads are proposed for NPDES-permitted WWTPs that discharge greater than 1 mgd within the Delta and in tributaries to the Delta downstream from major dams. In addition, these facilities (a) must implement a Pollution Prevention Plan for total mercury in compliance with Section 13263.3 of the California Water Code and maintain compliance with a USEPA approved pretreatment program, as applicable, and (b) must not exceed their 2006 annual average mercury concentration. After 2008, the WWTPs would need to

implement control actions or participate in an approved offset program to maintain the 2008 load limits.

- Clean Water Act 401 Water Quality Certifications for dredging projects in the Delta will include conditions to ensure that there will be no net increase in methyl and total mercury loads from dredging activities in Delta waterways, including sediment monitoring, management practices to minimize sediment releases, and protection of dredged material with elevated total mercury concentrations from erosion by 100-year precipitation or flow conditions.

- Agencies responsible for Cache Creek Settling Basin operations and maintenance should propose a plan by December 2007 to reduce total mercury discharges by 42 kg/yr and to begin implementation by December 2010.

Total mercury load reductions from the WWTPs and Cache Creek Settling Basin may be accomplished through a mercury offset program.

Offset Program for Total Mercury. An offset program would allow dischargers to offset methyl or total mercury loads in excess of requirements by implementing more feasible or cost effective projects elsewhere in the watershed. Staff will work with the State Water Board, USEPA and stakeholders to develop the framework of an offset program for Central Valley Water Board consideration as a potential Basin Plan amendment in 2009. Amendments for methylmercury offsets would be considered after the characterization and control studies are completed.

Strategy for Expansion of Existing Public Education Programs. The Central Valley Water Board and its staff will work with the State Water Board, OEHHA, CDHS, local county health departments, and dischargers to develop a strategy for expanding and sustaining existing public education and outreach programs and will support stakeholders implementing the strategy.

Additional methyl and total mercury control actions will be identified by Phase II of the proposed implementation program and implemented in future Basin Plan amendments. By December 2014, the Central Valley Water Board will evaluate the completed characterization and control studies, proposed methyl and total mercury control actions and implementation schedules, and the environmental impacts of the proposed control actions.

Proposed Modifications to Basin Plan Chapter V (Surveillance and Monitoring)

Staff proposes a surveillance and monitoring program to ensure compliance with the fish tissue methylmercury objectives and methyl and total mercury reduction strategy proposed for addition to Chapters III and IV. The program includes fish tissue, water, and sediment monitoring.

DRAFT BASIN PLAN AMENDMENT

Text additions to the existing Basin Plan language are underlined and text deletions are indicated by ~~strikethrough~~. (NOTE: For this review edition, underline is not used for ease of reading- everything below is new language) Revise Basin Plan sections as follows:

Revise Chapter II (Existing and Potential Beneficial Uses), Table II-1 to add a footnote for Sacramento San Joaquin Delta:

Sacramento San Joaquin Delta (8,9, a)

Footnote (a) Sacramento San Joaquin Delta: COMM

Revise Chapter III (Water Quality Objectives), Methylmercury, to add as follows:

For the Sacramento San Joaquin Delta, the average methylmercury concentrations shall not exceed 0.08 and 0.24 mg methylmercury/ kg, wet weight, in muscle tissue of large trophic level 3 and 4 fish, respectively (150-500 mm total length unless legal catch size designated by the California Department of Fish and Game). These objectives are protective of (a) humans eating 32 g/day (1 meal/week) of commonly consumed, large fish; and (b) all wildlife species that consume large fish. The average methylmercury concentrations shall not exceed 0.03 mg methylmercury/ kg, wet weight, in whole trophic level 2 and 3 fish less than 50 mm in length. This objective is protective of wildlife species that consume small fish.

Revise Chapter IV (Implementation), under "Mercury Discharges in the Sacramento River and San Joaquin River Basins" to add:

Delta Methylmercury Program:

The goal of the control program is to achieve the methylmercury fish tissue objectives throughout the Delta. Fish tissue methylmercury concentrations are directly linked to the concentration of methylmercury in the water. Available information indicates that meeting an annual average aqueous methylmercury (unfiltered) goal of 0.06 ng/l will achieve the Delta fish tissue objectives. The aqueous methylmercury goal applies to the average annual ambient water methylmercury concentration. In some areas of the Delta significant reductions in methylmercury inputs are necessary to achieve the aqueous methylmercury goal. Methylmercury allocations and implementation of actions to address the sources set forth in this control program will result in achieving the aqueous methylmercury goal. Allocations are specific to Delta subareas, which are shown on Figure IV-1.

The concentration of total mercury in sediment is one of the main factors for methylmercury production. Point and nonpoint sources contribute total mercury to the Delta. The control program includes requirements for addressing sediment and for controlling total mercury loads from point and nonpoint sources. The control program includes requirements to reduce total mercury loading to San Francisco Bay, as required by the San Francisco Bay Water Board's total mercury allocations for the Central Valley.

Prohibition

The discharge of methylmercury into the Delta or its tributaries within the legal Delta and for 30 miles beyond the legal boundary (Figure IV-1) is conditionally prohibited after 31 December 2014, unless 1) the fish tissue mercury objectives for the Delta are being met, 2) methylmercury allocations have been met, 3) the methylmercury discharge concentration is less than 0.06 ng/l, or 4) responsible parties have conducted methylmercury **Characterization and Control Studies** by December 2012 and implemented control actions in accordance with Regional Board adopted plans and schedules.

Characterization and Control Studies

The control program requires **Characterization and Control Studies** to evaluate methylmercury and total mercury concentrations and loads in source and receiving waters and discharges, identify variables that control methylmercury production, and propose management practices and implementation schedules to reduce methylmercury loads and concentrations. Responsible parties within each source category can develop collaborative studies and will be considered to be in compliance with the study requirements if they participate in the collaborative studies and propose management practices and implementation schedules.

Responsible parties for **Characterization and Control Studies** shall submit study plans by December 2007 to the Regional Board for approval by the Executive Officer. By December 2009, responsible parties shall submit a report documenting progress towards complying with the study requirements and management practice development. By December 2012, the responsible parties shall complete the studies and submit results and proposed management practices to the Regional Board. In January 2008 and January 2010 staff will report to the Regional Board the responsible parties' progress towards compliance with the studies and management practice development.

By December 2014, the Regional Board will evaluate the completed studies, proposed management practices, implementation schedules, and the environmental impacts of proposed methylmercury control actions. The Regional Board may consider allowing any combination of the following: modification of methylmercury allocations or total mercury limits; adoption of management practices and implementation schedules for on-site methylmercury controls; or adoption of an offset program to compensate for loads in excess of the methylmercury allocations.

The State Water Board is requested to fund or conduct studies to develop and evaluate management practices to reduce methylmercury discharges from nonpoint sources.

The Central Valley and San Francisco Water Boards will conduct coordinated studies to evaluate methyl and total mercury loads that flux between the jurisdictional areas for future allocation revisions.

Methylmercury allocations are provided in Tables A, B, D, F, and G. Methylmercury allocations are required to be met by 2014 unless dischargers or discharger groups complete the studies and submit to the Regional Board the management plan discussed below by December 2012. Full compliance with the methylmercury allocations is required by 31 December 2029, or sooner if required by Regional Board adopted implementation schedules.

Agricultural Lands and Wetlands

This control program applies to agricultural lands and wetlands in the Delta and within 30 miles (Figure IV-1) of the Delta. Methylmercury allocations are included in Table A for each Delta

subarea. The allocations for each subarea apply to the sum of existing discharges. Responsible parties are encouraged to work together in each subarea to:

1. Complete **Characterization and Control Studies** to characterize methyl and total mercury concentrations and loads in source and receiving waters and discharges, and to identify variables that control methylmercury production; and
2. Develop management practices that can be implemented to achieve the methylmercury allocations, a time schedule for implementation and, if applicable, detailed information documenting why fully achieving the methylmercury allocations is infeasible.

Dischargers responsible for new sources of methylmercury from agricultural lands and wetlands that are proposed to be initiated between the effective date of this amendment and 2014 are prohibited unless discharge methylmercury concentrations are less than the source water methylmercury concentrations or the discharger conducts studies as discussed above and increases in methylmercury are approved by the Executive Officer. New discharges that begin after the effective date of this amendment may necessitate adjustments to the allocation assignments in 2014.

Discharges from agricultural lands and wetlands that exceed source water methylmercury concentrations are prohibited after 31 December 2014 in subareas where load allocations are not being met unless responsible parties (individuals or groups) complete the studies and submit to the Regional Board the management practices discussed above and increases in methylmercury are approved by the Executive Officer.

NPDES Wastewater Treatment Facilities

Methylmercury allocations apply to NPDES permitted facilities in the Delta or within 30 miles of the Delta (Table B, Figure IV-1). Methylmercury allocations are required to be met by 2014 unless dischargers or discharger groups complete the studies and submit to the Regional Board the management plan discussed below by December 2012. Facilities that discharge greater than 1 mgd are required to:

1. Complete **Characterization and Control Studies** to characterize methyl and total mercury concentrations and loads in influent, effluent and receiving waters, and to identify variables that control methylmercury production; and
2. Develop plans to achieve the methylmercury allocations, a time schedule for implementation and, if applicable, detailed information documenting why fully achieving the allocations is infeasible.

Smaller facilities are encouraged to coordinate and cooperate in the above studies.

Dischargers of new sources of methylmercury that are proposed to be initiated between the effective date of this amendment and 2014 are prohibited unless the discharge is less than 0.06 ng/l methylmercury, or the discharger conducts studies as discussed above and increases above 0.06 ng/l methylmercury are approved by the Executive Officer. New discharges that begin after the effective date of this amendment may necessitate adjustments to the allocations.

Total mercury load limits apply to NPDES permitted facilities that discharge greater than 1 mgd within the Delta and in tributaries to the Delta downstream from major dams (Table C).[1] The total mercury limit for a facility shall be the facility's 2008 annual mercury load. Facilities shall report their 2008 loads by 31 March 2009. Annual loads are calculated by the summation of monthly concentrations times monthly flows.[2]

From the effective date of this amendment until the date the Central Valley Water Board adopts a final Mercury Offset Program, a facility is in compliance with the total mercury limits if it (1) implements a Pollution Prevention Plan for total mercury in compliance with Section 13263.3 of the California Water Code and maintains compliance with a USEPA approved pretreatment program, as applicable, and (2) does not exceed the 2006 annual average mercury concentration.[3]

Dischargers whose mercury loads exceed the 2008 load limit shall maintain a Pollution Prevention Plan and either reduce their loads to surface waters to achieve the limit or offset the excess mercury in conformance with the final Mercury Offset Program. A Mercury Offset Program is anticipated for Regional Board consideration in 2009. In the absence of a final Mercury Offset Program, the 2008 load limits will continue to be in effect. After 2008, the Executive Officer will evaluate new NPDES facilities on an individual basis when establishing total mercury load limits in permits.

Facilities that discharge less than 1 mgd are required to implement a Pollution Prevention Plan for total mercury in compliance with Section 13263.3 of the California Water Code and maintain compliance with a USEPA approved pretreatment program, as applicable.

Urban Runoff

Methylmercury allocations for urban runoff shall be implemented through NPDES Municipal Separate Storm Sewer Systems (MS4) permits issued to urban runoff management agencies in the Delta and within 30 miles of the Delta (Table D, Figure IV-1). The urban runoff allocations implicitly include all current and future urban discharges not otherwise addressed by another allocation within the geographic boundaries of urban runoff management agencies, including but not limited to Caltrans roadway and non-roadway facilities and rights-of-way, public facilities, properties proximate to banks of waterways, industrial facilities, and construction sites. Methylmercury allocations are required to be met by 2014 unless MS4 dischargers or discharger groups complete the studies and submit to the Regional Board the management plan discussed below by December 2012.

Phase I MS4s are required to:

1. Complete **Characterization and Control Studies** to characterize methyl and total mercury concentrations and loads in MS4 discharges and receiving waters and to identify variables that control methylmercury production; and

[1] Major reservoirs and lakes in the Sacramento Basin are Shasta, Whiskeytown, Oroville, Englebright, Camp Far West, Folsom/Natoma, and Black Butte, Indian Valley, Clear Lake and Lake Berryessa. Major reservoirs and lakes in the San Joaquin Basin are Camanche, New Hogan, New Melones/Tulloch, Don Pedro, McClure, Burns, Owens, Eastman, Hensley, Millerton and Marsh Creek.

[2] Monthly concentration shall be an average of all effluent concentration data collected that month. Non-detect measurements shall use one-half of the detection level (minimum detection level 0.2 ng/l) for the calculations.

[3] Annual average concentration shall be average of monthly averages. Monthly averages are the mean of all data collected during a given month.

2. Develop best management practices that can be implemented to achieve the methylmercury allocations and maintain the total mercury load limits, a time schedule for implementation and, if applicable, detailed information documenting why full achievement of the methylmercury allocations and total mercury load limits is infeasible.

Phase II MS4s are encouraged to coordinate with Phase I MS4s in completion of the studies described above. MS4s that are designated after the effective date of this amendment may necessitate adjustments to the methylmercury allocations. Urban areas (including industrial and construction discharges) that are not regulated by MS4s shall maintain their existing methylmercury discharges. These discharges will be assigned allocations in 2014.

Total mercury limits apply to MS4 (Table E) discharges within the Delta and in tributaries to the Delta downstream from major dams. The total mercury limit for MS4 discharges shall be the 10-year annual average mercury load calculated for 2002 through 2011. Annual total mercury loads shall be calculated by the average total mercury concentration measured in urban runoff multiplied by annual average runoff volume for 2002 through 2011, or alternate method approved by the Executive Officer.

Dredging

There shall be no net increase in methyl and total mercury loads from dredging activities in Delta waterways. Clean Water Act 401 Water Quality Certifications shall include the following conditions:

1. Characterize methyl and total mercury loads removed from Delta waterways by dredging activities.
2. Conduct before-and-after surface sediment monitoring to ensure that newly-exposed sediment has an average total mercury concentration less than the surface material before dredging.
3. Employ management practices during and after dredging activities to minimize sediment releases into water column.
4. Ensure that disposal of dredged material with average total mercury concentrations greater than 0.2 mg/kg (dry weight, fines < 63 microns), is protected from erosion by 100-year precipitation or flow conditions.
5. Ensure that return flows from the disposal of dredged material do not have methylmercury concentrations greater than the receiving water concentration.

Flood Conveyance Flows and
Water Management and Storage

Methylmercury flux from sediment in open waters of the Delta needs to be maintained at existing levels (Table F).

Flood conveyance inputs from the Yolo Bypass, water management activities (e.g., the South Delta Improvement Project or new or expanded reservoirs), and seasonal wetland flooding may influence ambient methylmercury levels in the Delta. Parties responsible for flood conveyance activities include USACE, State Reclamation Board, DWR, USFWS, CDFG, Sacramento Area Flood Control Agency, local reclamation districts, levee and drainage districts and municipalities. Parties responsible for salinity control and other water management activities in the Delta include SWRCB, DWR and USBR.

The Regional Board requires that the parties responsible for flood conveyance projects coordinate with wetland and agricultural landowners to characterize existing methylmercury discharges to open waters from lands immersed by managed flood flows and to develop control measures.

In addition, the Regional Board requires that the parties responsible for water supply management in the Delta conduct collaborative studies to characterize baseline methylmercury production in open channels during different flow conditions in the Delta, in particular:

1. Evaluate direct and indirect effects of flow management practices on sulfate concentrations and methylmercury production in the Delta; and
2. Conduct sulfate amendment studies to determine whether sulfate concentrations affect methylmercury production rates and resulting ambient water column concentrations in the Delta.

Changes in flood conveyance, water delivery to, diversions from, or storage in the Delta, and salinity standards or flow management practices used to maintain current salinity standards could affect methyl and total mercury loading to the Delta. The SWRCB is requested to evaluate direct and indirect effects of changes in salinity standards on methylmercury production. If changes to the salinity standards (or flow management practices used to maintain current salinity standards) would increase methylmercury levels, then the SWRCB should require responsible agencies to conduct studies and develop management plans to reduce methylmercury concentrations. As necessary, management plans should be developed prior to changes in salinity standards.

Inter-agency agreements and coordination with SWRCB authority over water rights will be needed to ensure that existing and potential impacts are properly characterized and controlled.

The Regional Board requires that responsible parties for existing and proposed flood conveyance and water management projects complete **Characterization and Control Studies** by 2012. By December 2014, the Regional Board will evaluate the studies and management practices and determine whether to implement control actions or modify allocations. Responsible agencies may participate in a mercury offset program.

Cache Creek Settling Basin

The Delta mercury control program requires a total mercury reduction of 53 kg/yr from the Cache Creek Settling Basin in addition to mercury reduction efforts described in the Cache Creek Watershed Program. The tributary total mercury load limits are based on 20-year average loads for water years 1984 through 2003, which includes a mix of wet and dry years that is statistically similar to what has occurred in the Sacramento Basin over the last 100 years. By 31 December 2007, the Regional Board requires that responsible agencies for Cache Creek Settling Basin operations and maintenance propose a plan for removing contaminated sediments and improving the trapping efficiency of the basin to reduce the total mercury discharge. Responsible agencies include DWR and USACE. By 31 December 2010, responsible agencies shall implement control actions to reduce total mercury loads from the Settling Basin. Total mercury load reductions from the Cache Creek Settling Basin may be accomplished, in part, through a mercury offset program.

Table G identifies the methylmercury allocation for the Cache Creek Settling Basin. The Regional Board requires that by 31 December 2012 responsible agencies complete **Characterization and Control Studies** and develop management practices to achieve the methylmercury allocation.

Additional mercury control actions for the settling basin may be required to further reduce mercury in the Yolo Bypass.

Tributary Watersheds

Table G identifies methylmercury allocations for tributary inputs to the Delta.

The sum total of 20-year average mercury loads from the American River, Putah Creek, and Feather River needs to be reduced by 38 kg/yr, from 104 to 66 kg/yr. This reduction will be implemented by future TMDL programs for these watersheds. The tributary total mercury load limits are based on 20-year average loads for water years 1984 through 2003, which includes a mix of wet and dry years that is statistically similar to what has occurred in the Sacramento Basin over the last 100 years. Additional total mercury load reductions may be required to accomplish future water quality objectives to be established for those watersheds.

Public Education

The local county health departments should expand current outreach and education regarding the risks of consuming fish containing mercury, emphasizing portions of the population that are at highest risk, such as pregnant women and children. The Regional Board will work towards developing a strategy for public outreach and education and will support stakeholders implementing the strategy. The Regional Board encourages dischargers of methyl and total mercury to promote public education programs and work with at-risk fish consumers to develop community-based risk reduction and mitigation strategies aimed at lowering their risk to eating locally caught fish.

The Regional Board recommends that the California Department of Health Services provide expanded public outreach and education to reduce methylmercury health risks to people consuming local fish.

Adaptive Implementation

The Regional Board recognizes that meeting the methylmercury allocations, total mercury limits, and other requirements of this control program may be difficult. Therefore, prior to the 2014 deadline for achieving the methylmercury allocations specified in this control program, the Regional Board will evaluate the results of the control studies and implementation plans developed by dischargers to determine whether adjustments in allocations or time schedules need to be made. By 2014, the Regional Board will consider adoption of an offset program that will allow dischargers to offset methylmercury in excess of requirements by implementing more feasible or cost effective projects elsewhere in the watershed. Participation in the offset program will be allowed only after dischargers have completed control studies, as described in this control program, and clearly demonstrated that meeting the methylmercury allocations or total mercury limits is infeasible or impracticable.

Monitoring and Review

The monitoring guidance for the Delta is described in Chapter V, Surveillance and Monitoring.

Recommendations for Other Agencies

Atmospheric deposition of mercury in the Central Valley tributary watersheds needs to be maintained at existing levels. Atmospheric deposition is a statewide issue and some sources originate outside of the state. A memorandum of understanding should be developed between USEPA, the State Water Board, and the Air Resources Board to conduct studies to evaluate local and statewide air emissions and deposition patterns and to develop and implement a load reduction program(s). The study results and implementation options will be reviewed by the Regional Board in 2014.

Revise Chapter IV (Implementation), under "Estimated Costs of Agricultural Water Quality Control Programs and Potential Sources of Financing" to add:

The total estimated costs for management practices to meet the Delta methylmercury objective range from $xxx to $xxx. The estimated costs for discharger compliance monitoring, planning and evaluation range from $xxx to $xxx million. The estimated total annual costs range from $xxx million to $xxx million (2006 dollars).

Potential funding sources include:

1. Those identified in the San Joaquin River Subsurface Agricultural Drainage Control Program and the Pesticide Control Program.

Revise Chapter V, (Surveillance and Monitoring) to add:

Delta

The Central Valley Water Board will use the following criteria to determine compliance with the methylmercury fish tissue objectives in the Sacramento-San Joaquin Delta.

The representative fish species for each trophic level shall be:

- Trophic Level 4: bass (largemouth and striped), white catfish, crappie, and Sacramento pikeminnow.
- Trophic Level 3: American shad, black bullhead, bluegill, carp, Chinook salmon, redear sunfish, Sacramento blackfish, Sacramento sucker, and white sturgeon.
- Trophic Level 2 or 3 fish less than 50 mm: inland silverside, juvenile bluegill, mosquitofish, red shiner, threadfin shad, or other fish of this size commonly consumed by wildlife species in the Delta.

Sample sets for large trophic level 3 and 4 fish shall include three species from each trophic level and shall include anadromous and non-anadromous fish. Sample sets for the large fish shall include a range of sizes of fish between 150-500 mm total length, with average length of 350 mm. Striped bass, largemouth bass, and sturgeon caught for mercury analysis should be within the CDFG legal catch size limits. Sample sets for fish less than 50 mm shall include at least two fish species. To attain compliance, the average concentration of methylmercury in sample sets for each subarea shall equal the objectives for three consecutive years. In any subarea, if multiple species for a particular trophic level are not available, one species in the sample set is acceptable.

The largemouth bass implementation goal may be used as a cost-effective tool to track progress toward meeting the fish tissue objectives. The largemouth bass implementation goal is 0.24 mg methylmercury/ wet weight muscle tissue of largemouth bass at a standard, total length of

350 mm. This implementation goal corresponds to the fish tissue objectives and is expected to protect humans and wildlife species that eat fish from a mixture of trophic levels.

The aqueous methylmercury goal is in the form of the annual average concentration in unfiltered samples of ambient water. Water samples should be collected seasonally throughout the year during typical flow conditions.

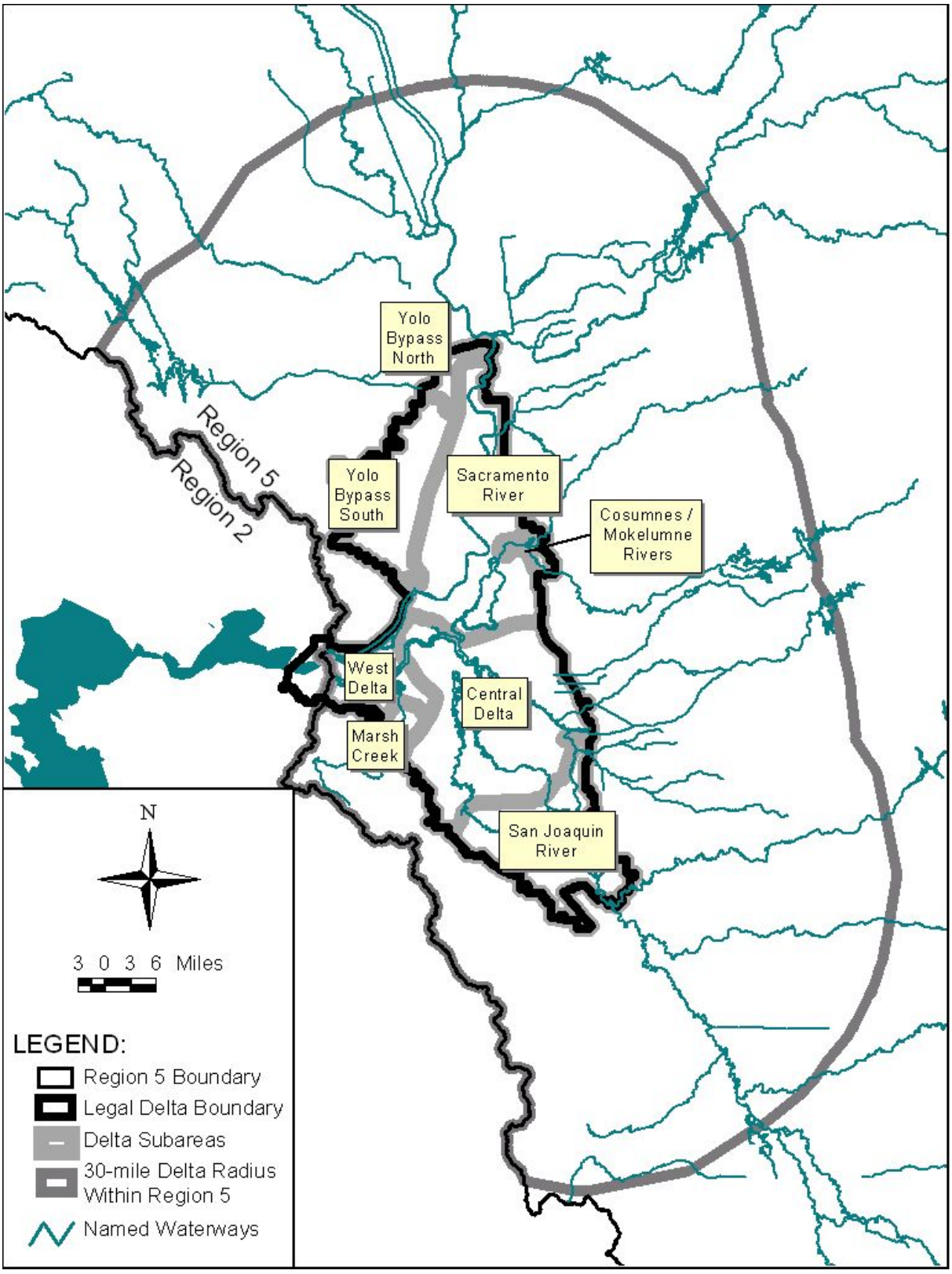

Figure IV-1 Delta Subareas for Delta Methylmercury Program

TABLE A
AGRICULTURE AND WETLAND METHYLMERCURY ALLOCATIONS

DELTA SUBAREA RECEIVING SOURCE INPUT	PROXIMITY TO DELTA	SOURCE	EXISTING LOAD (g/yr)	PERCENT REDUCTION REQUIRED	LOAD ALLOCATION (g/yr)
Central Delta	Within Subarea	Agriculture	37	0%	37
		Wetlands	135	0%	135
	Within 30-Miles Upstream of Subarea	Agriculture	*Upstream values to be included in the next draft of the Proposed BPA staff report.*		
		Wetlands			
Marsh Creek	Within Subarea	Agriculture	2.2	75%	0.58
		Wetlands	0.40	75%	0.10
	Within 30-Miles Upstream of Subarea	Agriculture	*tbd*	75%	*tbd*
		Wetlands	*tbd*	75%	*tbd*
Mokelumne/ Cosumnes Rivers	Within Subarea	Agriculture	1.6	65%	0.56
		Wetlands	12	65%	4.2
	Within 30-Miles Upstream of Subarea	Agriculture	*tbd*	65%	*tbd*
		Wetlands	*tbd*	65%	*tbd*
Sacramento River	Within Subarea	Agriculture	36	54%	19
		Wetlands	66	54%	35
	Within 30-Miles Upstream of Subarea	Agriculture	*tbd*	54%	*tbd*
		Wetlands	*tbd*	54%	*tbd*
San Joaquin River	Within Subarea	Agriculture	23	82%	4.1
		Wetlands	18	82%	3.2
	Within 30-Miles Upstream of Subarea	Agriculture	*tbd*	82%	*tbd*
		Wetlands	*tbd*	82%	*tbd*
West Delta	Within Subarea	Agriculture	4.1	0%	4.1
		Wetlands	121	0%	121
	Within 30-Miles Upstream of Subarea	Agriculture	*tbd*	0%	*tbd*
		Wetlands	*tbd*	0%	*tbd*
Yolo Bypass	Within Subarea	Agriculture	19	83%	3.2
		Wetlands	415	85%	62
	Within 30-Miles Upstream of Subarea	Agriculture	*tbd*	83%	*tbd*
		Wetlands	*tbd*	85%	*tbd*

TABLE B
MUNICIPAL AND INDUSTRIAL WASTEWATER
METHYLMERCURY WASTE LOAD ALLOCATIONS BY DELTA SUBAREA

PERMITTEE	PERMIT #	EXISTING MeHg CONCEN-TRATION (ng/l)	PERCENT REDUCTION REQUIRED	ALLOCATED MeHg CONCEN-TRATION (ng/l) (a)	ALLOCATED MeHg LOAD (g/yr)	2005 EFFLUENT VOLUME (mgd) (b)
Central Delta Subarea – Within Delta Facilities (c)						
Discovery Bay WWTP	CA0078590	0.20	0%	0.20	0.42	1.5
Lodi (City of) White Slough WWTP	CA0079243	0.13	0%	0.13	0.72	4.0
San Joaquin Co DPW CSA 31-Flag City WWTP	CA0082848	0.09	0%	0.09	0.007	0.06
Marsh Creek Subarea – Within Delta Facilities (c)						
Brentwood (City of) WWTP	CA0082660	0.02	0%	0.02	(a)	3.1
Mokelumne River Subarea –Facilities that Discharge to Tributaries within 30 Miles of the Subarea (c)						
CDFG Mokelumne River Fish Hatchery	CA0004791		64%			
El Dorado ID Deer Creek WWTP	CA0078662		64%			
El Dorado ID El Dorado Hills WWTP	CA0078671		64%			
Galt WWTP	CA0081434		64%			
Sacramento River Subarea – Within-Subarea Facilities						
Rio Vista (City of) WWTP	CA0079588	0.16	46%	0.09	0.06	0.47
Rio Vista (City of) Trilogy WWTP	CA0083771	(d)				0.2
SRCSD-Elk Grove Walnut Grove WWTP	CA0078794	1.7	46%	0.91	0.10	0.08
Sacramento (City of) Combined WWTP	CA0079111	(e)				1.3
SRCSD Sacramento River WWTP	CA0077682	0.73	46%	0.39	84	156
West Sacramento (City of) WWTP	CA0079171	0.05	100%	0.05	(a)	5.6
Sacramento River Subarea – Facilities that Discharge to Tributaries within 30 Miles Upstream of the Subarea						
Auburn WWTP	CA0077712		46%			
CDFG Nimbus Fish Hatchery	CA0004774		46%			
DGS Office of State Publishing	CA0078875		46%			
Formica Corporation Sierra Plant	CA0004057		46%			
Lincoln WWTP	CA0084476		46%			
Pacific Coast Sprout Farms, Inc. (Sacramento)	CA0082961		46%			
Placer Co. SA #28 Zone #6	CA0079341		46%			
Placer Co. SMD #3 WWTP	CA0079367		46%			
Proctor & Gamble Co. WWTP	CA0004316		46%			
Roseville Dry Creek WTP	CA0079502		46%			
Roseville Pleasant Grove WTP	CA0084573		46%			
United Auburn Indian Community Casino WWTP	CA0084697		46%			
San Joaquin River Subarea – Within-Subarea Facilities						
Deuel Vocational Inst. WWTP	CA0078093	0.02	0%	0.02	(a)	0.47
Manteca Aggregate Sand Plant	CA0082783	0.032	0%	0.03	(a)	9.2
Manteca (City of) WWTP	CA0081558	0.216	72%	0.06	(a)	4.6
Mountain House CSD WWTP	CA0084271	(f)				5.4 (e)

Upstream values to be included in the next draft of the Proposed BPA staff report.

Upstream values to be included in the next draft of the Proposed BPA staff report.

PERMITTEE	PERMIT #	EXISTING MeHg CONCEN-TRATION (ng/l)	PERCENT REDUCTION REQUIRED	ALLOCATED MeHg CONCEN-TRATION (ng/l) (a)	ALLOCATED MeHg LOAD (g/yr)	2005 EFFLUENT VOLUME (mgd) (b)
Stockton (City of) WWTP	CA0079138	0.936	82%	0.17	6.4	28
Tracy (City of) WWTP	CA0079154	0.146	59%	0.06	(a)	9.5
San Joaquin River Subarea – Facilities that Discharge to Tributaries within 30 Miles Upstream of the Subarea						
Altamont Landfill and Resource	CA0083763		63%			
Canada Cove LP French Camp Golf & RV Park	CA0083682		63%			
Hershey Chocolate USA, Oakdale	CA0004146		63%			
J.F. Enterprises Worm Farm	CA0081949		63%			
Modesto ID Regional WTP	CA0083801		63%			
Modesto WQCF	CA0079103		63%			
Turlock WWTP	CA0078948		63%			
Yolo Bypass Subarea – Facilities that Discharge to Tributaries within 30 Miles Upstream of the Subarea						
Davis WWTP	CA0079049		78%			
University of California, Davis (UC Davis) WWTP	CA0077895		78%			
UC Davis Center for Aquatic Biology & Aquaculture	CA0083348		78%			
USDI UC Davis Aquatic Weed Laboratory	CA0083364		78%			
UC Davis Hydraulics Laboratory	CA0084182		78%			
Vacaville Easterly WWTP Plant	CA0077691		78%			
Woodland WWTP	CA0077950		78%			

Upstream values to be included in the next draft of the Proposed BPA staff report.

Upstream values to be included in the next draft of the Proposed BPA staff report.

(a) This table lists facilities within the Delta and within 30 miles of the Delta by the Delta subarea that receives the discharge. Facilities with existing average effluent methylmercury concentrations less than 0.06 ng/l, or allocated effluent methylmercury concentrations of 0.06 ng/l, do not have load limits; however, they do have concentration limits and must therefore maintain the concentrations listed in this table.

(b) Facilities that discharged greater than 1 mgd in 2005 shall participate in the **Characterization and Control Studies**.

(c) As of 20 March 2006, there are no permitted facilities that discharge to surface water within the Mokelumne River, Yolo Bypass and West Delta subareas or within 30 miles upstream of the Central Delta, West Delta and Marsh Creek subareas, other than heating/cooling, power, or groundwater treatment facilities. Available information indicates that such facilities do not contribute measurable amounts of methylmercury loading to the Delta. If future studies indicate otherwise, allocations will be developed for these facilities.

(d) During the period of TMDL development, several facilities in the Delta or within 30 miles of the Delta were undergoing substantial changes in treatment processes or other plant upgrades that could affect their methylmercury discharges. The Regional Board Executive Officer issued a California Water Code Section 13267 order to these facilities requiring the characterization of their effluent once plant upgrades are completed. Allocations for these facilities will be developed upon availability of methylmercury data representative of plant upgrades. Facilities that discharged greater than 1 mgd in 2005 shall participate in the **Characterization and Control Studies**.

(e) The Sacramento Combined WWTP (CA0079111) operates only when combined wastewater/storm flows that are normally conveyed to the SRCSD's Sacramento River WWTP (CA0077682) exceed 60 MGD. A California Water Code Section 13267 order was issued but effluent methylmercury data are not yet available.

(f) The Mountain House CSD WWTP (CA0084271) is included on this table because it has expected to begin discharge to surface water within the next two years. It is permitted to discharge 5.4 mgd, and therefore shall participate in the **Characterization and Control Studies**. A methylmercury allocation will be developed based on characterization of the effluent once plant upgrades are completed and discharge to surface water begins.

TABLE C
NPDES PERMITTED FACILITIES IN THE DELTA AND ITS TRIBUTARY WATERSHEDS DOWNSTREAM OF MAJOR DAMS WITH 2008 TOTAL MERCURY LOAD LIMITS

FACILITY (NPDES NO.)	FACILITY (NPDES NO.)
FACILITIES WITHIN THE DELTA	
Brentwood WWTP (CA0082660) Discovery Bay WWTP (CA0078590) Lodi White Slough WWTP (CA0079243) Manteca Aggregate Sand Plant (CA0082783) Manteca WWTP (CA0081558) Mountain House CSD WWTP (CA0084271)	Sacramento Combined WWTP (CA0079111) SRCSD Sacramento River WWTP (CA0077682) Stockton WWTP (CA0079138) Tracy WWTP (CA0079154) West Sacramento WWTP (CA0079171)
FACILITIES IN THE TRIBUTARY WATERSHEDS DOWNSTREAM OF MAJOR DAMS	
Aerojet Interim Groundwater Treatment Plant (CA0083861) Anderson WPCP (CA0077704) Atwater WWTF (CA0079197) Auburn WWTP (CA0077712) Boeing Company Interim Treatment System (CA0084891) Chico Regional WWTF (CA0079081) Corning Industries/ Domestic WWTF (CA0004995) Davis WTP (CA0079049) Defense Logistics Agency Sharpe Groundwater Cleanup (CA0081931) El Dorado Irrigation District Deer Creek WWTP (CA0078662) El Dorado Irrigation District El Dorado Hills WWTP (CA0078671) Galt WWTP (CA0081434) General Electric Co. GWCS (CA0081833) Hershey Chocolate USA, Oakdale (CA0004146) J.F. Shea Co Fawndale Rock and Asphalt (CA0083097) Lincoln WWTP (CA0084476) Linda Co Water Dist WPCP (CA0079651) Live Oak (CA0079022)	Merced WWTF (CA0079219) Modesto WQCF (CA0079103) Olivehurst PUD WWTP (CA0077836) Oroville WWTP (CA0079235) Pactiv Molded Pulp Mill (CA0004821) Placer Co. SMD #1 WWTP (CA0079316) Proctor & Gamble Co. WWTP (CA0004316) Red Bluff WWRP (CA0078891) Redding Clear Creek WWTP (CA0079731) Redding Stillwater WWTP (CA0082589) Roseville Dry Creek WTP (CA0079502) Roseville Pleasant Grove WTP (CA0084573) Turlock WWTP (CA0078948) University of California, Davis WTP (CA0077895) U.S. Air Force McClellan Air Force Base Groundwater Extraction & Treatment System (CA0081850) Vacaville Easterly Sewage Plant (CA0077691) Woodland WWTP (CA0077950) Yuba City WW Reclamation Plant (CA0079260)

MeHg load allocations will be updated to include upstream component in the next draft of the Proposed BPA staff report.

TABLE D
MS4 METHYLMERCURY WASTE LOAD ALLOCATIONS

PERMITTEE	PERMIT #	PROXIMITY TO DELTA (a)	EXISTING LOAD (g/yr)	PERCENT REDUCTION REQUIRED	LOAD ALLOCATION (g/yr) (a, b)	PHASE (c)
Central Delta Subarea Waste Load Allocations						
Contra Costa (County of)	CAS083313	Within-Delta & Upstream	0.75	0%	0.75	I
Lodi (City of)	CAS000004	Within-Delta & Upstream	0.053	0%	0.053	II
Port of Stockton MS4	CAS084077	Within-Delta & Upstream	0.39	0%	0.39	I
San Joaquin (County of)	CAS000004	Within-Delta & Upstream	0.57	0%	0.57	I
Stockton Area MS4	CAS083470	Within-Delta & Upstream	3.6	0%	3.6	I
Marsh Creek Subarea Waste Load Allocations						
Contra Costa (County of)	CAS083313	Within-Delta & Upstream	1.2	74%	0.31	I
Mokelumne River Subarea Waste Load Allocations						
Lodi (City of)	CAS000004	Upstream				II
Sacramento Area MS4	CAS082597	Upstream				I
San Joaquin (County of)	CAS000004	Within-Delta	0.51	65%	0.018	II
Sacramento River Subarea Waste Load Allocations						
Butte (County of)	CAS000004	Upstream				II
Chico (City of)	CAS000004	Upstream				II
Lincoln (City of)	CAS000004	Upstream				II
Loomis (City of)	CAS000004	Upstream				II
Marysville (City of)	CAS000004	Upstream				II
Rio Vista (City of)	CAS000004	Within-Delta & Upstream	0.014	46%	0.01	II
Rocklin (City of)	CAS000004	Upstream				II
Roseville (City of)	CAS000004	Upstream				II
Sacramento Area MS4	CAS082597	Within-Delta & Upstream	3.0	46%	1.6	I
San Joaquin (County of)	CAS000004	Within-Delta	0.19	46%	0.10	II
Solano (County of)	CAS000004	Within-Delta & Upstream	0.074	46%	0.040	II
Sutter (County of)	CAS000004	Upstream				II
West Sacramento (City of)	CAS000004	Within-Delta & Upstream	0.62	46%	0.33	II
Yolo (County of)	CAS000004	Within-Delta	0.073	46%	0.039	II
Yuba (County of)	CAS000004	Upstream				II
Yuba City (City of)	CAS000004	Upstream				II
San Joaquin River Subarea Waste Load Allocations						
Ceres (City of)	CAS000004	Upstream				II
Hughson (City of)	CAS000004	Upstream				II
Lathrop (City of)	CAS000004	Within-Delta & Upstream	0.27	75%	0.07	II
Manteca (City of)	CAS000004	Upstream				II
Modesto (City of)	CAS083526	Upstream				I
Oakdale (City of)	CAS000004	Upstream				II
Patterson (City of)	CAS000004	Upstream				II
Port of Stockton MS4	CAS084077	Within-Delta & Upstream	0.0096	75%	0.0024	I
Ripon (City of)	CAS000004	Upstream				II
Riverbank (City of)	CAS000004	Upstream				II

MeHg load allocations will be updated to include upstream component in the next draft of the Proposed BPA staff report.

TABLE D
MS4 METHYLMERCURY WASTE LOAD ALLOCATIONS

PERMITTEE	PERMIT #	PROXIMITY TO DELTA (a)	EXISTING LOAD (g/yr)	PERCENT REDUCTION REQUIRED	LOAD ALLOCATION (g/yr) (a, b)	PHASE (c)
San Joaquin (County of)	CAS000004	Within-Delta & Upstream	2.6	75%	0.65	II
Stanislaus (County of)	CAS000004	Upstream				II
Stockton Area MS4	CAS083470	Within-Delta & Upstream	0.50	75%	0.12	I
Tracy (City of)	CAS000004	Within-Delta & Upstream	1.8	75%	0.45	II
Turlock (City of)	CAS000004	Upstream				II
West Delta Subarea Waste Load Allocations						
Contra Costa (County of)	CAS083313	Within-Delta & Upstream	3.3	0%	3.3	I
Solano (County of)	CAS000004	Upstream				II
Yolo Bypass Subarea Waste Load Allocations						
Dixon (City of)	CAS000004	Upstream				II
Solano (County of)	CAS000004	Within-Delta & Upstream	0.085	75%	0.021	II
Vacaville (City of)	CAS000004	Upstream				II
West Sacramento (City of)	CAS000004	Within-Delta & Upstream	1.1	75%	0.27	II
Yolo (County of)	CAS000004	Within-Delta & Upstream	0.12	75%	0.030	II

(a) Some MS4s service areas span multiple Delta subareas and tributary watersheds, and are therefore listed more than once. Separate allocations are needed for each Delta subarea because different levels of reduction are required to achieve the water quality objective in each subarea. If an MS4 service area discharges within a given Delta subarea and within 30 miles upstream of that subarea, its within-Delta and upstream allocations are summed. The allocated methylmercury loads for all MS4s are based on the average methylmercury loads estimated in runoff from urban areas in or near the Delta for water years 2000 through 2003, a relatively dry period. Actual loads are expected to fluctuate with water volume and other factors. The above allocations may be adjusted based on new information for wet years as needed during future Basin Plan reviews.

(b) The methylmercury load allocations include all current and future permitted urban discharges not otherwise addressed by another allocation within the geographic boundaries of urban runoff management agencies, including but not limited to Caltrans facilities and rights-of-way (CAS000003), public facilities, properties proximate to banks of waterways, industrial facilities, and construction sites.

(c) Phase 1 MS4s shall participate in the **Characterization and Control Studies**.

TABLE E
MS4S IN THE DELTA AND ITS TRIBUTARY WATERSHEDS DOWNSTREAM OF MAJOR DAMS WITH 2014 TOTAL MERCURY LOAD LIMITS (a)

MS4 (NPDES NO.)	PHASE	MS4 (NPDES NO.)	PHASE
MS4s WITHIN THE DELTA			
Contra Costa (County of) (CAS083313)	I	San Joaquin (County of) (CAS000004)	II
Lathrop (City of) (CAS000004)	I	Solano (County of) (CAS000004)	II
Lodi (City of) (CAS000004)	II	Stockton Area MS4 (CAS083470)	I
Port of Stockton MS4 (CAS084077)	I	Tracy (City of) (CAS000004)	II
Rio Vista (City of) (CAS000004)	II	West Sacramento (City of) (CAS000004)	II
Sacramento Area MS4 (CAS082597)	I	Yolo (County of) (CAS000004)	II
MS4S IN THE TRIBUTARY WATERSHEDS DOWNSTREAM OF MAJOR DAMS			
Butte (County of) (CAS000004)	II	Ripon (City of) (CAS000004)	II
Ceres (City of) (CAS000004)	II	Riverbank (City of) (CAS000004)	II
Chico (City of) (CAS000004)	II	Rocklin (City of) (CAS000004)	II
Contra Costa (County of) (CAS083313)	I	Roseville (City of) (CAS000004)	II
Dixon (City of) (CAS000004)	II	Sacramento Area MS4 (CAS082597)	I
Hughson (City of) (CAS000004)	II	San Joaquin (County of) (CAS000004)	II
Lathrop (City of) (CAS000004)	II	Solano (County of) (CAS000004)	II
Lincoln (City of) (CAS000004)	II	Stanislaus (County of) (CAS000004)	II
Lodi (City of) (CAS000004)	II	Stockton Area MS4 (CAS083470)	I
Loomis (City of) (CAS000004)	II	Sutter (County of) (CAS000004)	II
Manteca (City of) (CAS000004)	II	Tracy (City of) (CAS000004)	II
Marysville (City of) (CAS000004)	II	Turlock (City of) (CAS000004)	II
Modesto (City of) (CAS083526)	I	Vacaville (City of) (CAS000004)	II
Oakdale (City of) (CAS000004)	II	West Sacramento (City of) (CAS000004)	II
Patterson (City of) (CAS000004)	II	Yolo (County of) (CAS000004)	II
Port of Stockton MS4 (CAS084077)	I	Yuba City (City of) (CAS000004)	II

(a) Including CalTrans Statewide permit #CAS000003

MeHg load allocations will be updated to include upstream component in the next draft of the Proposed BPA staff report.

TABLE F
OPEN WATER METHYLMERCURY LOAD ALLOCATIONS

DELTA SUBAREA	PROXIMITY TO DELTA	EXISTING LOAD (g/yr)	PERCENT REDUCTION REQUIRED	LOAD ALLOCATION (g/yr) (a)
Central Delta	Within Subarea	301	0%	301
	Within 30 Miles			
Marsh Creek	Within Subarea	0.03	0%	0.03
	Within 30 Miles			
Mokelumne River	Within Subarea	1.1	0%	1.1
	Within 30 Miles			
Sacramento River	Within Subarea	118	0%	118
	Within 30 Miles			
San Joaquin River	Within Subarea	20	0%	20
	Within 30 Miles			
West Delta	Within Subarea	190	0%	190
	Within 30 Miles			
Yolo Bypass	Within Subarea	86	0%	86
	Within 30 Miles			

(a) Open water methylmercury load allocations are based on methylmercury flux from sediment in open water habitat (data collected in May 2000 and October 2001).

TABLE G
TRIBUTARY WATERSHED METHYLMERCURY ALLOCATIONS

DELTA SUBAREA	TRIBUTARY (a)		MeHg LOAD (g/yr) (b,c)	MeHg CONCENTRATION (ng/l)
Central Delta	Calaveras River		25	0.14
	Bear/Mosher Creeks		11	0.31
	Bethany Reservoir Area		(d)	(d)
Marsh Creek	Marsh Creek		0.50	0.07
Mokelumne River	Mokelumne River		38	0.06
San Joaquin River	San Joaquin River		123	0.06
	French Camp Slough		4.5	0.06
	Manteca-Escalon, Mountain House & Corral Hollow Creeks Areas		(d)	(d)
West Delta	Antioch & Montezuma Hills Areas		(d)	(d)
Sacramento Basin (b,d)	Delta Inputs	Sacramento River	1,078	0.06
		Prospect Slough	81	0.06
		Morrison Creek	4.4	0.06
		Ulatis Creek	2.0	0.06
	Upstream Tributaries	Cache Creek Settling Basin	28	0.06
		American River	139	0.05 (e)
		Feather River	407	0.06
		Putah Creek	24	0.06

(a) The methylmercury load allocations include point and nonpoint sources identified within 30 miles of the Delta, which are addressed by the allocations and characterization and control studies described in previous sections and tables.

(b) Methylmercury allocations are assigned to tributary inputs to the Delta as well as to upstream tributaries in the Sacramento Basin that are required to substantially reduce total mercury loading. The methylmercury allocations for the Sacramento Basin tributaries are based on reductions needed to achieve the implementation goal for ambient methylmercury in the Delta. Methylmercury reduction strategies shall be developed for other upstream tributaries during implementation of the Delta mercury control program and development of TMDLs for upstream water bodies identified as impaired on the Clean Water Act Section 303(d) List.

(c) Methylmercury load allocations are based on water years 2000 through 2003, a relative dry period. Annual loads are expected to fluctuate with water volume and other factors.

(d) Ambient mercury data are not available for smaller tributaries to the Delta and Sacramento Basin. As a result, methylmercury loads are limited to existing conditions.

(e) Methylmercury concentrations in American River exports average 0.05 ng/l. As a result, its methylmercury allocation is set to 0.05 ng/l.

AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS FOR THE CONTROL OF METHYLMERCURY AND TOTAL MERCURY IN THE SACRAMENTO-SAN JOAQUIN DELTA ESTUARY

Draft Report for Scientific Peer Review

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303(d) List	Clean Water Act Section 303(d) List of Impaired Waterbodies
ATSDR	U.S. Agency for Toxic Substances and Disease Registry
BAF	Bioaccumulation factor
Basin Plan	Central Valley Region Water Quality Control Plan for the Sacramento River and San Joaquin River Basins
BCF	Bioconcentration factor
BMP	Best management practice
bwt	Body weight
Caltrans	California Department of Transportation
CCSB	Cache Creek Settling Basin
CDEC	California Data Exchange Center
CDFG	California Department of Fish and Games
CDHS	California Department of Health Services
CEQA	California Environmental Quality Act
cfs	Cubic feet per second
CFSII	Continuing survey of Food Intake by Individuals
CTR	California Toxics Rule
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board (a.k.a. Central Valley Water Board)
CWA	Federal Clean Water Act
DMC	Delta Mendota Canal
DTMC	Delta Tributaries Mercury Council
DWR	California Department of Water Resources
EC	Electrical Conductivity
FCM	Food Chain multipliers
GIS	Geographic Information Systems
GLWQI	Great Lakes Water Quality Initiative Final Rule
HCI	Hydrologic Classification Index
Hg	Mercury
LMB	Largemouth bass
LOAEC's	Lowest observed adverse effect concentrations
LOAEL	Lowest-observable adverse effect level
MCL	California/USEPA drinking water standards maximum contaminant levels
mgd	Million gallons per day
MES	Mass Emissions Strategy
MeHg	Methylmercury
MS4	Municipal Separate Storm Sewer System
MRC	Mercury Study Report to Congress
MRL	ATSDR Minimal Risk Level
na	Not available
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act
NOAEL	No-observable adverse effect level
NPDES	National Pollutant Discharge Elimination System
NPS	Non point source
NRC	National Research Council
o/oo	Parts per thousand (salinity)
OEHHA	Office of Environmental Health Hazard Assessment
RfD	Reference dose
RSC	Relative source contribution
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board (a.k.a. San Francisco Bay Water Board)
SFEI	San Francisco Estuary Institute
SRCSD	Sacramento Regional County Sanitation District

LIST OF ACRONYMS *continued*

SRWP	Sacramento River Watershed Program
SLC	State Lands Commission
SWMP	Storm Water Management Plan
SWP	State Water Project
SWRCB	State Water Resources Control Board (a.k.a. State Water Board)
TDSL	Total diet safe level
TL3	Trophic level 3
TL4	Trophic level 4
TLR	Trophic level ratios
TMDL	Total Maximum Daily Load
TMDL Report	Sacramento – San Joaquin Delta Estuary TMDL for Methylmercury Staff Report, provided as Appendix A to this report.
TSS	Total suspended solids
UC Davis	University of California-Davis
USACE	US Army Corps of Engineers
USBR	US Bureau of Reclamation
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFDA	US Food and Drug Administration
USFWS	US Fish and Wildlife Service
WHO	World Health Organization
ww	Wet weight concentration (e.g., for fish tissue mercury concentrations)
WWTP	Wastewater treatment plants
X2	Location in the Bay-Delta Estuary with 2-o/oo bottom salinity

UNITS OF MEASURE

μg	microgram
μg/g	microgram per gram
μg/l	microgram per liter
μm	micrometer
cfs	cubic feet per second
cm	centimeter
g	Gram
g/day	gram per day
g/l	gram per liter
in/yr	inches per year
kg	kilogram
l	Liter
m	Meter
mg	milligram
mg/g	milligram per gram
mgd	million gallons per day
ml	milliliter
mm	millimeter
ng	nanograms
ng/l	nanograms per liter
o/oo	parts per thousand (salinity)
ppb	parts per billion; usually μg/kg
ppm	parts per million; usually mg/kg or μg/g
ppt	parts per trillion; usually ng/kg

RECOMMENDED FORMAT FOR COMMENT LETTERS

Comment letters to the Central Valley Water Board on staff recommendations serve two purposes: 1) to identify areas of agreement; and 2) to suggest revisions to staff recommendations. Clear statements of both areas of agreement and suggested revisions will assist the Central Valley Water Board and staff in understanding the recommendations of the commenter. In order to aid staff in identifying suggested revisions and to respond to the specific issues raised by the commenter, the following format for comment letters is suggested.

Format for Comments Suggesting Revisions

The suggested format is to number the comment, state in one sentence the topic upon which the comment is directed, provide a supporting argument, and make a specific recommendation. Supporting arguments should include citations, where appropriate. The recommended format is:

Comment #. *One sentence description or title for the comment.*
Section #, Paragraph #
Text describing suggested revision to the proposed Basin Plan amendment language or staff report.

For suggested revisions to the proposed Basin Plan amendment language, please use underline/strikeout to show changes from the staff proposal. For suggested changes to the staff report, please clearly indicate the section number (e.g., Section 1.2.3) and paragraph number (e.g., 4th paragraph) of the text on which you are basing your comments. The discussion related to the suggested revisions should be clearly supported by reference to applicable law or scientific or technical reports, where appropriate.

Format for Comments Supporting Staff Recommendations

If the commenter concurs with a staff recommendation, a statement to that effect will assist the Central Valley Water Board in determining what action, if any, to take on the staff recommendation. The recommended format is:

Comment #. *One sentence description or title for the comment.*
Section #, Paragraph #
Statement of concurrence.

The provision(s) of the proposed Basin Plan Amendment that the commenter supports should be clearly stated. The commenter may want to provide their reason for supporting the provision of the proposed Basin Plan Amendment, especially if it differs from the staff rationale, or if the staff rationale could be further enhanced or clarified. Additional legal or scientific citations can also be provided.

1 INTRODUCTION AND BACKGROUND

California Water Code Section 13240 requires each of the state's Regional Water Quality Control Boards (Regional Water Boards) to prepare and adopt Water Quality Control Plans, also known as Basin Plans, to regulate water quality. In addition to complying with California law, Basin Plan also satisfy the requirements of Section 303(c) of the federal Clean Water Act (CWA), which requires states to adopt water quality standards to meet federal regulatory requirements. Basin Plans are adopted and amended by the Regional Water Boards using a structured process that includes opportunities for full public participation and state environmental review. A Basin Plan identifies:

- Beneficial uses to be protected;
- Water quality objectives; and
- Implementation plans for achieving the water quality objectives.

This report addresses proposed amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (the Basin Plan). The Basin Plan currently in effect was originally adopted by the Central Valley Regional Water Quality Control Board (Central Valley Water Board or CVRWQCB) in 1975 and was updated in 1989, 1994 and 1998. The proposed amendments discussed in this Central Valley Water Board staff report address the regulation of methylmercury and total mercury in the Sacramento-San Joaquin Delta Estuary (the Delta).

More specifically, this report provides an evaluation of a variety of alternatives for water quality objectives for the Delta. In accordance with the California Environmental Quality Act (CEQA) and State Water Resources Control Board (State Water Board) regulations, this report also includes an evaluation of the potential environmental impacts of the proposed objectives. The Secretary of Resources has determined that the Basin Planning process is functionally equivalent to CEQA's requirement for preparation of environmental documentation. This report contains an analysis of alternatives and evaluation of their potential environmental impacts, the CEQA environmental checklist and conclusions of the environmental analysis. The Basin Planning process, including proposed Resolution and Basin Plan amendment, staff report, and response to public comments, satisfies the requirements of State Board Regulations for Implementation of CEQA, and Exempt Regulatory Programs found in the California Code of Regulations, Title 23, Division 3, Chapter 27, Article 6, beginning with Section 3720.

The proposed Basin Plan amendments for control of methylmercury and total mercury in the Delta will be legally applicable once they are adopted by the Central Valley Water Board and approved by the State Water Board, the State Office of Administrative Law, and the U.S. Environmental Protection Agency (USEPA). Implementation will begin after the Basin Plan amendments are legally applicable.

The Basin Plan amendments proposed for adoption by the Central Valley Water Board are presented after the Executive Summary at the beginning of this report. Chapter 1 of this report provides an introduction and background for the Basin Plan amendment process. Chapter 2 describes beneficial uses and existing conditions of the Delta and its tributaries. Chapter 3 presents the evaluation of possible water quality objectives. Chapter 4 describes alternatives for implementation. Chapter 5 details the monitoring and surveillance plan proposed for the Delta and its tributaries. Chapter 6 summarizes existing federal and state laws and policies that are relevant to the proposed water quality objectives and implementation plan described by the proposed Basin Plan amendments. Chapter 7 provides the CEQA checklist. Appendix A is the methylmercury total maximum daily load (TMDL) technical staff report for the Delta

(the TMDL Report), which provides the basis of many sections of the proposed Basin Plan amendments and this staff report. Appendix B provides the calculations for the different water quality objective alternatives. Appendix C provides the calculations of the estimated costs that support the economic consideration of the proposed water quality objectives and implementation program.

1.1 Watershed Area to Be Considered

The Sacramento-San Joaquin Delta Estuary combined with the San Francisco Bay (the Bay-Delta Estuary) forms the largest estuary on the North American western coast. The Delta encompasses a maze of river channels and embanked islands encompassing approximately 738,000 acres in Alameda, Contra Costa, Sacramento, San Joaquin, Solano and Yolo counties (DWR, 1995).

This staff report and the proposed Basin Plan amendments address the impairment inside of the legal Delta boundary (Figure 1.1). The implementation plan addresses methylmercury and total mercury loads in the legal Delta and sources of both in the tributary watersheds. To better address tributary sources, the Delta was divided into eight sub-regions based on hydrology. These include:

- Sacramento River: This subarea is dominated by Sacramento River flows. It is bound to the east by the legal Delta boundary and to the west by the eastern levee of the Sacramento Deep Water Ship Channel. Although drawn as a defined line, the Sacramento River subarea's boundary with the South Yolo Bypass, Central Delta, and West Delta subareas is defined by a gradient in water quality characteristics that varies depending on the tidal cycle, magnitude of wet weather flows, diversions by within-Delta control structures, and releases from reservoirs in the upstream watersheds. The boundary shown in Figure 1.1 is based on available information and may shift as results from ongoing and future studies become available.
- Yolo-Bypass (North & South): The Yolo Bypass is a floodplain on the west side of the lower Sacramento River (see Figure E-1 in the Delta Mercury TMDL report). The Fremont and Sacramento weirs route floodwaters to the Yolo Bypass from the Sacramento and Feather Rivers and their associated tributary watersheds. Cache and Putah Creeks, Willow Slough and the Knights Landing Ridge Cut from the Colusa Basin Drain all drain directly to the Yolo Bypass. Only the southern portion of the Yolo Bypass lies within the legal Delta. This portion is divided into "north" and "south" subareas by Lisbon Weir, which limits the range of tidal fluctuations upstream of the weir.
- Cosumnes/Mokelumne: This subarea includes the lower Cosumnes and Mokelumne Rivers and is defined by the legal Delta boundary to the east and the Delta Cross Channel confluence with the Mokelumne to the west.
- Marsh Creek: This subarea is defined by the portion of the Marsh Creek watershed within the legal Delta boundary that is upstream of tidal effects.
- West Delta: This subarea encompasses the confluence of the Sacramento and San Joaquin Rivers, which transport water from the Central Valley to the San Francisco Bay. The western boundary of the West Delta subarea is defined by the jurisdictional boundary between the Central Valley Water Board (Region 5) and the San Francisco Bay Water Board (Region 2). Water quality characteristics are determined by the tidal cycle, magnitude of wet weather flows, controlled flow diversions by within-Delta structures, and releases from reservoirs in the upstream watersheds.

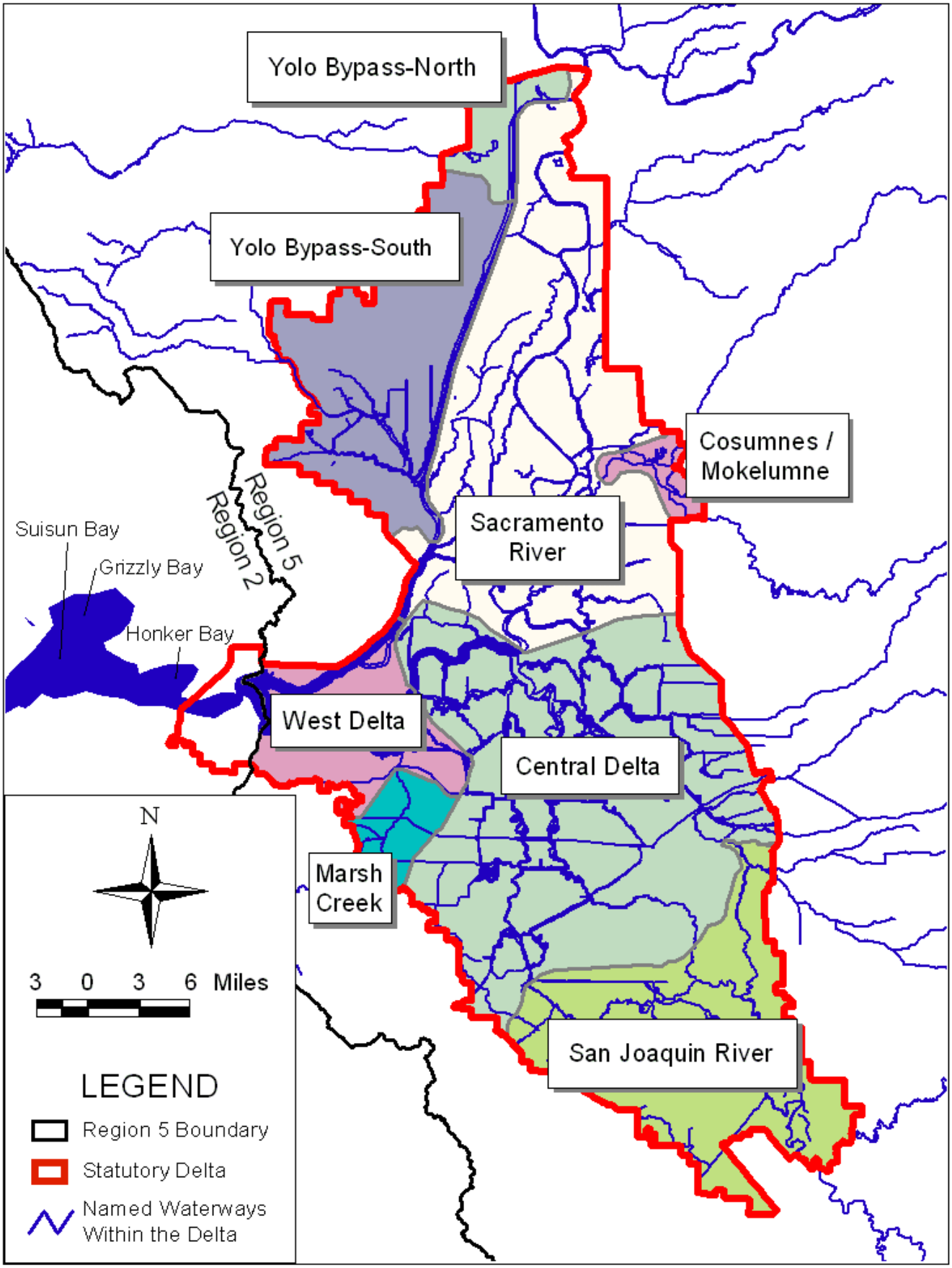

Figure 1.1: The Legal Delta Watershed Boundary including the TMDL Eight Hydrologic Subareas

- Central Delta: This subarea includes a myriad of natural and constructed channels that transport water from the upper watersheds to San Francisco Bay to the west and the State and federal pumps to the southwest. The Central Delta tends to be most influenced by Sacramento River water.
- San Joaquin River: This subarea is defined by the legal Delta boundary to the east and south, and the Grantline Canal coupled with the beginning of the Stockton Deep Water Channel to the north. At present, the San Joaquin River is almost entirely diverted out of the Delta by the Old River and Grantline Canal for export to areas south of the Delta via the State and federal pumping facilities near Tracy.

1.2 Need for an Amendment to the Basin Plan

Section 303(d)(1)(A) of the Clean Water Act requires the Regional Water Boards to:

- Identify the Regions' waters that do not comply with water quality standards;
- Rank the impaired water bodies, taking into account factors including the severity of the pollution and the uses made of such waters; and
- Establish water quality management strategies (TMDLs) for those pollutants causing the impairments to ensure that impaired waters attain their beneficial uses.

In 1990, the State Water Board adopted the Clean Water Act 303(d) list that identified the Delta as impaired due to mercury pollution. The listing was based on a 1971 human health advisory issued for the Delta advising pregnant women and children not to consume striped bass. In 1994, an interim advisory was issued by the California Office of Environmental Health Hazard Assessment (OEHHA) for San Francisco Bay and the Delta recommending no consumption of large striped bass and shark because of elevated concentrations of mercury and polychlorinated biphenyls (OEHHA, 1994). Additional monitoring indicates that several more species, including largemouth bass and white catfish (two commonly-caught local sport fish), also have elevated concentrations of mercury in their tissue (Davis *et al.*, 2003; Slotton *et al.*, 2003; LWA, 2003; SWRCB-DWQ, 2002).

At this time, the Basin Plan does not include numeric water quality objectives for methylmercury or an implementation plan to control methylmercury or total mercury in the Delta. Therefore, Central Valley Water Board staff proposes that the Basin Plan be amended to include water quality objectives for methylmercury, as well as reduction strategies for methylmercury and total mercury for the Delta and its tributary watersheds.

The Central Valley Water Board will develop a water quality management strategy for each water body and pollutant in the Central Valley identified on California's 303(d) List. The management strategy for control of mercury in Delta is being conducted in several phases:

- Total Maximum Daily Load Development: Involves the technical analysis of the sources of pollutant, the fate and transport of those pollutants, the numeric target(s), and the amount of pollutant reduction that is necessary to attain the target(s). The TMDL Report for the Delta was released to the public for comment in August 2005. The TMDL Report formed the basis of many parts of the proposed Basin Plan amendment staff report. Comments received on the August 2005 TMDL Report were considered in the development of this staff report and the updated TMDL Report presented in Appendix A.
- Basin Planning: Focuses on the development of a Basin Plan amendment and staff report that includes information and analyses required to comply with CEQA. The Basin Planning process

satisfies State Water Board regulations for the implementation of CEQA. The Basin Plan amendment will include those policies and regulations that the Central Valley Water Board believes are necessary to attain water quality objectives.

- Implementation: Establishes a framework that ensures that appropriate management practices or technologies are implemented (§13241 and §13242 of the Porter-Cologne Water Quality Act), including those elements necessary to meet federal TMDL requirements (CWA Section 303(d)).

2 BENEFICIAL USES AND EXISTING CONDITIONS

2.1 Delta Beneficial Uses Cited in the Basin Plan

The federal Clean Water Act and the state Porter-Cologne Water Quality Act require identification and protection of beneficial uses of water. Beneficial uses are designated by the Central Valley Water Board and are shown in Table II-1 of the Basin Plan (Central Valley Water Board, 1998). Table 2.1 lists the existing and potential beneficial uses of the Delta. The Delta provides habitat for warm and cold-water species of fish and their associated aquatic communities. Additionally, the Delta and its riparian areas provide valuable wildlife habitat. There is significant use of the Delta for commercial and sport fishing (COMM). Further, water is diverted from the Delta for municipal (MUN) and agricultural (AGR) use.

Beneficial uses of the Delta that are impaired due to elevated methylmercury levels in fish are recreational fishing (REC-1), wildlife habitat (WILD), and commercial and sport fishing. High methylmercury levels in fish pose risks for humans and wildlife that consume fish from the Delta waterways. A summary of Delta fish methylmercury levels is presented in Section 2.2. In addition, parts of the Delta (namely, Prospect Slough in the Yolo Bypass and Marsh Creek) may not support the municipal (MUN) beneficial use.

The Delta provides habitat for diverse populations of wildlife. Over two hundred and eighty species of birds and fifty species of fish inhabit the freshwater portion of the Delta, making it one of the State's most important wildlife habitats (Herbold *et al.*, 1992). Delta wildlife species that are primarily or exclusively piscivorous and therefore most likely at risk for mercury toxicity include: American mink, river otter, bald eagle, kingfisher, osprey, western grebe, common merganser, peregrine falcon, double crested cormorant, California least tern, and western snowy plover[1] (USEPA, 1997; CDFG 2002). Peregrine falcons are not piscivorous, but they eat birds that feed in the aquatic food chain. Bald eagles, California least terns and peregrine falcons are listed by the State of California or by the U.S. Fish and Wildlife Service (USFWS) as either threatened or endangered species. The Delta is a foraging and possible wintering habitat for bald eagles (USFWS, 2004). California least terns also forage in the Delta. There is at least one nesting colony of these terns within the Delta (USFWS, 2004). Although most of the Delta habitat is not preferred by peregrine falcons for nesting, several pairs have nested on bridges in the area (Linthicum, 2003). Although other wildlife species eat fish in the Delta, consumption patterns of the species listed above span the range of sizes of fish consumed.

2.2 Existing Concentrations of Methylmercury in Delta Fish

High levels of mercury in fish are of concern to humans and wildlife that consume Delta fish. Table 2.2 summarizes average methylmercury concentrations in fish tissue for the eight Delta subareas by trophic

[1] The CDFG *California Wildlife Habitat Relationships* database also reports observations of brown pelicans and clapper rails in the Delta. Both of these species are federally listed as endangered and depend on the aquatic food web. However, staff of the Biological Contaminants Division of the US Geological Survey (USGS) confirmed that brown pelicans and clapper rails prefer salt water habitats and are only occasional visitors to the Delta regions (personal communication from Dr. S. Schwarzbach, USGS, to J. Cooke, CVRWQCB, April 2003).

Table 2.1: Existing Beneficial Uses of the Delta

Beneficial Use (a)	**Status**
Municipal and domestic supply (MUN)	Existing (b)
Agriculture – irrigation and stock watering (AGR)	Existing
Industry – process (PROC) and service supply (IND)	Existing
Contact recreation (REC-1) (c)	Existing (b)
Non-contact recreation (REC-2) (c)	Existing
Freshwater habitat (warm and cold water species)	Existing
Spawning, reproduction and/or early development of fish (SPWN) (warm water species)	Existing
Wildlife habitat (WILD)	Existing (b)
Migration of aquatic organisms (MIGR) (warm and cold water species)	Existing
Navigation (NAV)	Existing

(a) This table lists the beneficial uses designated for the Delta in Table II-1 of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Central Valley Water Board, 1998; http://www.waterboards.ca.gov/centralvalley/available_documents/index.html)

(b) These are beneficial uses impaired by mercury in the Delta.

(c) REC-1 includes recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing and fishing. REC-2 includes recreational activities involving proximity to water, but where there is generally no body contact with water, nor any likelihood of ingestion of water. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, hunting and sightseeing.

Table 2.2: Weighted-Average Methylmercury Concentrations in Delta Fish

Key Species of Concern	**Fish Species Trophic Level Food Group**	**Species-Specific Target** (mg/kg)	**MeHg Concentration by Delta Subarea** (mg/kg) (a)							
			Central Delta	Marsh Creek (b)	Moke-lumne River	Sacra-mento River	San Joaquin River	West Delta	Yolo Bypass North (c)	Yolo Bypass South (c)
Human	TL4 Fish (150-500 mm)	0.24	0.26	na	0.92	0.56	0.57	0.32	0.51	0.53
Human	TL3 Fish (150-500 mm)	0.08	0.08	na	0.28	0.21	0.12	0.11	0.28	0.19
Osprey	TL4 Fish (150-350 mm)	0.26	0.20	na	0.75	0.46	0.42	0.24	0.50	0.47
Grebe	TL3 Fish (150-350 mm)	0.08	0.08	na	0.29	0.17	0.12	0.08	na	na
Kingfisher	TL3 Fish (50-150 mm)	0.05	0.03	0.10	0.09	0.04	0.04	0.03	na	0.07
Least Tern	TL2/3 Fish (<50 mm)	0.03	0.02	na	0.07	0.03	0.04	0.03	na	0.05

(a) Samples were comprised of both individual fish and composites of multiple fish. Weighted average mercury concentration is based on the number of fish in the composite samples analyzed, rather than the number of samples. Fish mercury data were not available for every TL food group in every Delta subarea.

(b) Fish data collected in 1995 and 1996.

(c) Fish mercury data were not available for all trophic level food groups in the Yolo Bypass.

level (TL).[2] Common small (<50 mm) TL2 and 3 fish species in the Delta include inland silverside, mosquitofish and threadfin shad. Common TL3 fish include bluegill, carp, redear sunfish, Sacramento sucker, and Chinook salmon (a.k.a. king salmon). Common TL4 fish include largemouth and striped bass, channel and white catfish and Sacramento pikeminnow. Most fish data summarized in Table 2.2 were collected between 1998 and 2001. Additional information is provided in the TMDL Report.

Significant regional variations in fish tissue mercury concentrations exist in the Delta. Elevated concentrations occur along the periphery of the Delta while lower body burdens are measured in the central Delta. Concentrations are greater than levels recommended as safe by the USEPA and USFWS (see Chapter 3) at all locations except in the central Delta. Percent reductions in fish methylmercury levels ranging from 0% to more than 70% in the peripheral Delta subareas will be needed to achieve fish mercury levels protective of humans and wildlife species that consume Delta fish.

2.3 Proposed Modification to Beneficial Uses Identified in the Basin Plan

As noted in Section 2.1, the Basin Plan lists the existing and potential uses of the Delta. The Basin Plan provides a standard definition for commercial and sport fishing (COMM). The COMM designation is defined as "uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes" (Central Valley Water Board, 1998). The Basin Plan does not include the COMM designation for the Delta. However, commercial and sport fishing is a past and present use of the Delta. To document the current use of the Delta as a fishery, staff proposes to include the COMM beneficial use designation in the Basin Plan for the Delta. The inclusion is not expected to change fishing habits or patterns.

The Delta provides habitat for as many as fifty freshwater, saltwater and anadromous fishes (Moyle, 2002), including popular sport species such as bass, salmon, sturgeon and catfish. The California Department of Fish and Game (CDFG) issues commercial fishing licenses in California and reports active commercial fishing in the Delta. CDFG's Marine Resources website provides summary data for commercial landings and associated costs for fishing years 2001 and 2002. The predominant species targeted include bay shrimp, crayfish and threadfin shad. Threadfin shad are used mainly as baitfish for catching striped bass. Historical data for other commercial fishing activities are not available.

Noncommercial fishing is common throughout the Delta and takes place year round. On average, sport fishing license sales in the six Delta counties account for 19% of all licenses issued in California for striped bass, salmon and steelhead. It is unknown what portion of those licenses was purchased for fishing within the statutory Delta boundary. However, creel surveys and interviews indicate that sport and subsistence anglers actively fish the Delta waterways year-round by boat and from banks. CDFG's

[2] Trophic levels are the hierarchical strata of a food web characterized by organisms that are the same number of steps removed from the primary producers. The USEPA's 1997 Mercury Study Report to Congress used the following criteria to designate trophic levels based on an organism's feeding habits:

Trophic level 1: Phytoplankton.
Trophic level 2: Zooplankton, benthic invertebrates, and plant-eating fish. (Delta examples: clams, shrimp).
Trophic level 3: Organisms that eat zooplankton and other TL2 organisms. (Delta examples: bluegill, carp, crayfish, Sacramento splittail, salmon, sucker, shad, sturgeon and yellowfin goby).
Trophic level 4: Organisms that eat trophic level 3 organisms (Delta examples: largemouth, smallmouth, and striped bass; white catfish; and crappie).

creel surveys indicate that multiple species are caught and kept, including catfish, striped bass, black bass, and Sacramento pike minnow, chinook salmon (a.k.a. king salmon), American shad, splittail, sunfish, sturgeon, starry flounder, common carp, Sacramento sucker, steelhead trout and rainbow trout. California Department of Health Services (CDHS) Environmental Health Investigations Branch staff conducted interviews of selected groups in the Delta region and found that members of Southeast Asian, Latino, African-American, and Russian communities regularly eat local fish, especially striped bass and catfish (CDHS, 2004). Several fishing derbies for striped bass, black bass and sturgeon take place in the Delta every year. Sacramento blackfish, shimofuri goby and clams may also be collected from the Delta (Moyle, 2002; anecdotal information). However, the CDFG creel surveys (CDFG, 2000-2001) and anecdotal information provided by CDFG staff (Schroyer, 2003, personal communication to J. Cooke) indicate that many Delta anglers target salmon, sunfish, striped bass, largemouth bass and catfish and are unlikely to take home clams and shrimp species. For specific information on fish licenses and CDFG's creel survey data, refer to Appendix C of the TMDL Report.

3 WATER QUALITY OBJECTIVES

Water quality objectives are established in Basin Plans by the Regional Water Boards to reasonably protect beneficial uses. Water quality objectives provide a specific basis for the measurement and maintenance of water quality.

The Basin Plan for the Sacramento and San Joaquin River Basins does not contain numeric water quality objectives for fish tissue methylmercury within the Delta legal boundary and not until recently have such water quality objectives been proposed for any of the Delta's tributary watersheds (e.g., Clear Lake and Cache Creek). Methylmercury concentration in fish tissue is considered an appropriate objective for the Delta because: it is the most toxic form of mercury; it is the form by which humans and wildlife may be exposed in the Delta at levels to cause adverse effects; it provides the most direct assessment of fishery conditions and improvement; and a safe fishery is the foremost unmet beneficial use of the Delta.[3] This chapter evaluates five possible alternatives for water quality objectives to address methylmercury in Delta fish.

In developing the alternative water quality objectives below, Central Valley Water Board staff considered existing conditions in the Delta (see Chapter 2) and reviewed numerical guidelines and recommended criteria available from USEPA, USFWS and other agencies. The evaluation also considered that Delta waterways are listed as impaired for mercury because of the existence of fish consumption advisories (CDHS, 1971; CDHS, 1993; OEHHA, 1994). Fish tissue concentrations in the Delta exceed human and wildlife guidelines provided by NAS, USEPA and the USFWS. The proposed objectives incorporate the current USEPA and USFWS information regarding methylmercury toxicity to humans and wildlife (see Section 4.5.1 of the Delta TMDL Report)**.**

3.1 Fish Tissue Objective Alternatives Considered

Five alternatives were evaluated in developing water quality objectives for the regulation of methylmercury in fish for the Delta (Table 3.1). Staff used a basic formula that incorporates the safe daily intake of methylmercury (reference dose), consumer's body weight, and fish consumption rate for calculating water quality objectives for Alternatives 2-5. Staff computed average safe concentrations of methylmercury in fish that would protect humans and wildlife consuming those fish. The Delta TMDL Report shows how the safe level of mercury in prey fish varies between fish trophic level and length. The TMDL Report provides an evaluation of the safe level of mercury in fish for human consumption under varied scenarios for consumption rates and for varied trophic level (TL) distributions (see Table 4.5 in the TMDL Report). Further, the TMDL report standardizes all the safe levels for human and wildlife consumption in terms of large TL4 fish to determine whether safe levels in large fish consumed by human and wildlife would equate to safe levels in smaller fish consumed by wildlife. The calculation of the

[3] In the Delta TMDL report, Central Valley Water Board staff provided safe methylmercury concentrations in piscivorous and omnivorous birds preyed upon by bald eagles and peregrine falcons. Existing concentrations in avian prey are not known. Because humans do not consume such avian prey, it would be difficult to determine whether meeting a safe concentration in avian prey is protective of human fish consumers. For these reasons, Central Valley Water Board staff is not proposing tissue objectives for avian prey species. The USFWS concluded that meeting protective levels in fish tissue would adequately reduce methylmercury levels in the avian prey species that eat fish or invertebrates from the Delta (USFWS, 2004).

Table 3.1 Comparison of Water Quality Objective Alternatives

Alternative	**Proposed Objective for MeHg in Large TL4 Fish** (mg/kg)	**Assumed Consumption Rates & Trophic Levels of Fish**
2	0.58	3.8 g/day of TL2 fish, 8.0 g/day of TL3 fish, and 5.7 g/day of TL4 fish, for a sum of 17.5 g/day
3 (a)	0.29	17.5 g/day of large TL4 fish
4 (a)	0.24	32 g/day of a 50/50 mix of large TL3 & 4 fish
5	0.05	142.4 g/day of large TL4 fish

(a) Alternatives 3 and 4 also propose an objective for small, TL2 and 3 fish of 0.03 mg/kg to protect wildlife species that eat small fish. In addition, Alternative 4 proposes a methylmercury objective for large TL3 fish of 0.08 mg/kg.

different alternatives is included in Appendix B. Chapter 4 (Numeric Targets) of the TMDL Report contains detailed descriptions of these calculations.

The main variations in the alternatives are the amount and trophic level of fish that can be safely consumed by humans. The following sections describe the alternative numeric objectives with their corresponding human consumption rates. The calculations supporting the alternative water quality objects are summarized in Appendix D. Alternatives 3 and 4 include an objective for small (less than 50 mm total length) TL2/3 fish to ensure that wildlife species eating these fish are protected. Numeric objectives are proposed as average concentrations in fish muscle tissue (for large fish) or in whole fish (for small fish).

Although the water quality objective calculations use bodyweights and consumption rates for adult humans, the resulting fish tissue levels protect children. The OEHHA has published a table of sizes of typical meals of fish that correspond to smaller bodyweights (OEHHA, 1999). Children would only be at risk of mercury toxicity if they consumed more than the average portion for their body size.

Wildlife species most at risk from methylmercury effects are primarily or exclusively piscivorous. Sensitive species at risk in the Delta are: American mink, bald eagle, California least tern, common merganser, double crested cormorant, kingfisher, osprey, peregrine falcon, river otter, western grebe, and western snowy plover. Evaluation of the alternative objectives takes into account protection for sensitive wildlife.

3.1.1 Alternative 1. No Action

Alternative 1 contains no water quality objective for the Delta. If site-specific objectives are not adopted for mercury in the Delta, the existing narrative objective of the Basin Plan still applies. The narrative objective for toxicity states: "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal or aquatic life." The primary criterion that would likely be used to interpret the narrative objective is the California Toxics Rule (CTR) criterion of 50 ng/l for total recoverable mercury in the water column.

Alternatives 2 through 5 propose numerical water quality objectives in fish tissue to explain the narrative objective in the current Basin Plan and facilitate implementation of a water quality management strategy

to reduce methylmercury levels in Delta fish. Numeric objectives for the Delta are needed to assess progress in attaining the beneficial uses. In particular, the implementation plan proposed as part of the Basin Plan Amendment is based upon numeric water quality objectives in fish tissue and quantitative reductions required to meet those goals.

3.1.2 Alternative 2. Water Quality Objective of 0.58 mg/kg Methylmercury in Large TL4 Fish

Under this alternative, the Central Valley Water Board staff proposes a methylmercury fish tissue concentration of **0.58 mg methylmercury/kg muscle tissue, wet weight for large** TL4 fish (legal size if designated by CDFG, otherwise 150-500 mm total length). This methylmercury fish tissue concentration incorporates the following assumption: humans will eat 17.5 grams/day of freshwater/estuarine fish from the Delta (one fish meal every two weeks) and commercial (marine) fish of 12.46 g/day (0.4 fish meals per week; USEPA, 2000b).[4] The adult body weight is assumed to be 70 kg. Central Valley Water Board staff used the USEPA reference dose (RfD) for humans as an acceptable daily intake level (0.1 micrograms per kilogram body weight per day; USEPA 2001). The consumption rates for local and commercial fish are based on a national food intake survey, which found that 90% of the nation's population eats 17.5 g/day or less of local (freshwater) fish. The 17.5 g/day rate includes fish or shellfish from trophic levels 2, 3, and 4 (consumption rates of 3.8, 8.0, and 5.7 g/day, respectively).

Levels of mercury in TL2 and 3 fish that correspond to the objective for TL4 fish are 0.04 and 0.20 mg/kg, respectively. By meeting the TL4 objective, these concentrations will be met as well.

Alternative 2 uses the same methods that the USEPA used in developing its recommended methylmercury criterion to protect human health (USEPA, 2001). To protect human health, the USEPA recommends an ambient water quality criterion of 0.3 mg/kg methylmercury in fish tissue, on a wet weight basis.[5] The USEPA criterion represents the concentration in fish tissue that should not be exceeded based on a total consumption of locally caught fish of 17.5 g/day. Hence, Alternative 2 assumes that the sum of all of the fish consumed locally will not exceed the USEPA human health criterion of 0.3 mg methylmercury/kg fish tissue, and that people will eat a mixture of locally caught freshwater or estuarine fish from trophic levels 2, 3, and 4 in the proportions described above. This alternative is not protective of humans eating mainly TL4 fish, such as bass and catfish.

This alternative also would not be protective of several piscivorous wildlife species. As shown in Table 4.3 of the TMDL Report, mink, double-crested cormorant, belted kingfisher, and western snowy plover would be protected by this alternative, but bald eagle, osprey, river otter, grebe, common merganser and least tern would not be protected. Because this alternative does not fully protect wildlife, no objective is proposed for the small TL2 and 3 fish.

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[4] One meal of fish for an adult human is assumed to be eight ounces of uncooked fish or shellfish (6 ounces cooked). The consumption rate of 17.5 g/day is equivalent to one eight-ounce meal per 2-week period, or four ounces per week (2.3 meals/month).

[5] USEPA's criterion of 0.3 was rounded to one significant digit from 0.288 mg/kg. The water quality objective alternatives calculations were based on a methylmercury in fish tissue concentration of 0.29 mg/kg to incorporate two significant digits. Detailed calculations are included in Appendix B.

3.1.3 Alternative 3. Water Quality Objectives of 0.29 mg/kg Methylmercury in Large TL4 fish and 0.03 mg/kg in Small TL2/3 Fish.

Under this alternative, Central Valley Water Board staff proposes two objectives: a methylmercury fish tissue objective of **0.29 mg methylmercury/kg muscle tissue, wet weight,** for large TL4 fish (legal size if designated by CDFG, otherwise 150-500 mm total length) and a concentration of **0.03 mg methylmercury/kg whole fish, wet weight, for small TL2 and 3 fish** (less than 50 mm total length).

The Alternative 3 water quality objective for large fish uses the USEPA default consumption rates and takes into consideration available CDFG creel survey information for types of Delta fish eaten by humans. This objective assumes that humans eat 17.5 g/day of fish from the Delta and 12.5 g/day of commercial fish. The USEPA criterion assumed that, on average, humans eat a mixed bag of freshwater and estuarine fish from trophic levels 2, 3 and 4. However, USEPA's 2001 Water Quality Criterion report stated that the criterion could be adjusted on a site-specific basis to reflect local conditions and/or specific populations of concern, including the consumption rates of local fish.

Incorporating local angling information into USEPA's criterion, Central Valley Water Board staff assigned the criterion of 0.29 mg/kg as the average concentration of methylmercury in large TL4 fish. Trophic level 2 species, such as clams, shrimp and shimofuri goby, are harvested from the Delta for human consumption. However, CDFG creel surveys (CDFG, 2000-2001) and anecdotal information provided by CDFG staff (Schroyer, 2003) indicate that many Delta anglers target TL3 and TL4 fish and are unlikely to take home TL2 species. Creel surveys show that anglers may target an almost even mix of TL3 (American shad, salmon, sunfish, and splittail) and TL4 (catfish and striped bass) fish in the Sacramento and Mokelumne Rivers subareas of the Delta and primarily TL4 species in other parts of the Delta. This interpretation still assumes a consumption rate of one meal every two weeks, but takes into consideration that, when eating locally caught fish, many Delta consumers prefer to eat only TL4 fish.

Reductions in methylmercury levels needed to achieve the objective in large TL4 fish are expected to produce reductions in smaller fish sufficient to fully protect wildlife species. This is because methylmercury concentrations in large TL4 fish show statistically significant, positive relationships with concentrations in smaller fish and in fish in different trophic levels. To ensure that wildlife species eating small fish are protected, this Alternative includes an objective of 0.03 mg/kg methylmercury in TL2 and 3 fish less than 50 mm in length. This objective represents the safe level for prey consumed by the California least tern, a piscivorous species listed by the federal government as endangered. As shown in the TMDL Report, this proposed small fish objective also would protect other birds consuming small fish in the Delta, including herons, rails, egrets, the Western snowy plover, and other species of concern.

3.1.4 Alternative 4. Water Quality Objectives of 0.24 mg/kg Methylmercury in Large TL4 Fish, 0.08 mg/kg in Large TL3 fish and 0.03 mg/kg in Small TL2/3 Fish.

Alternative 4 proposes three objectives. For large fish, the proposed objectives are average methylmercury concentrations of **0.08 and 0.24 mg methylmercury/ kg, wet weight, in muscle tissue of large TL3 and 4 fish**, respectively (legal size if designated by CDFG, otherwise 150-500 mm total length). These objectives are protective of (a) humans eating 32 g/day (1 meal/week) of commonly consumed, legal size fish; and (b) all wildlife species that consume large fish. For small fish, the proposed objective is **0.03 mg methylmercury/ kg, wet weight, in whole TL2 and 3 fish less than 50 mm** in total length. This objective is protective of wildlife species that consume small fish.

The proposed water quality objectives for large TL3 and 4 fish in Alternative 4 would protect humans consuming Delta and commercial fish and are protective of wildlife species. Calculation of this Alternative used the same methodology as in Alternative 3, with one exception: human consumers of local fish are assumed to eat a greater amount of fish in their diet, eating an equal share of TL3 and TL4 fish at a rate of 32 g/day (one fish meal per week). This higher consumption rate is based on a San Francisco Bay consumption survey (CDHS & SFEI, 2001a). One meal per week is also used by OEHHA in development of fish consumption advisories (OEHHA, 2004; 2005).

A detailed anglers consumption survey for San Francisco Bay was conducted in 1998 and 1999. The consumption rates for the 95th percentile of anglers that were "consumers" (consumed Bay fish at least once prior to the interview) was 32 g/day. San Francisco Bay Water Board staff recommended this consumption rate for development of a San Francisco Bay water quality objective.

Alternative 4 assumes that people eat a 50/50 combination of TL3 and 4 fish. As described above, CDFG creel surveys indicate that people in the Sacramento River and Mokelumne subareas of the Delta fish for a mix of these trophic levels. In several small surveys of subpopulations in the Delta, the California Department of Health Services found that while striped bass is frequently sought, people who regularly eat Delta fish take home species from both trophic levels 3 and 4 (CDHS, 2004; A. Ujihara, pers. comm.). The TL3 species of bluegill are available year-round. Popular fisheries such as salmon and shad, as well as other TL3 species, exist seasonally.

Alternative 4 includes an objective for small TL2 and 3 fish to protect wildlife eating small fish. Regression analyses between concentrations of methylmercury in large TL4 fish and fish of other species and sizes indicate that if the TL4 fish objective of 0.24 mg/kg is attained, methylmercury levels in small fish would decline sufficiently to protect wildlife. The small fish objective is included to ensure that wildlife and humans are fully protected by objectives that span a range of sizes and trophic levels.

3.1.5 Alternative 5. Water Quality Objective of 0.05 mg/kg Methylmercury in Large TL4 Fish

Alternative 5 proposes a methylmercury concentration of **0.05 mg methylmercury/kg muscle tissue** for large TL4 fish (legal catch length if designated by CDFG, otherwise 150-500 mm total length). This objective would protect segments of the population who, because of tradition or need, use locally caught fish as their primary source of protein. The objective is less than the level necessary to protect wildlife species. Calculations of this Alternative use the same methodology as in Alternative 3, with two exceptions: human consumers are assumed to eat 142.4 g/day (four to five fish meals per week) and eat no commercial fish. This high consumption rate is based on the 99th percentile consumption rate identified by a national food intake survey and recommended by the USEPA for subsistence fishers. An objective based on the consumption of mainly TL4 species is assumed to be most protective of high-rate consumers, some of whom are expected to eat mainly catfish and bass. Thus, staff proposed 0.05 mg/kg as the average concentration of methylmercury in locally caught TL4 fish.

A small fish objective is not proposed under Alternative 5. The concentration of 0.05 mg/kg in large TL4 fish is substantially lower than levels needed to protect wildlife consuming TL4 fish. It is also lower than the large TL4 fish methylmercury values that correspond to wildlife-protective methylmercury levels in other sizes of fish. Because the TL4 objective is so close to the safe level for the smallest fish (0.03 mg/kg), a separate objective for small fish is not necessary for this alternative.

3.2 Evaluation of Water Quality Objective Alternatives

Section 13241 of the Porter-Cologne Water Quality Act (State Water Code) identifies six factors that must be addressed when evaluating a water quality objective. Factors to be considered are:

- Past, present and probable future beneficial uses of water;
- Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto;
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area;
- Economic considerations;
- The need for developing housing within the region; and
- The need to develop and use recycled water.

The alternatives for water quality objectives are evaluated with respect to these factors in the following six sections. The alternatives are evaluated with respect to applicable state and federal policies in Chapter 6.

3.2.1 Beneficial Uses

Several beneficial uses Delta waters are considered impaired by mercury: recreational fishing (REC-1, COMM), wildlife habitat (WILD), and municipal and domestic supply (MUN). The proposed water quality objectives and implementation plan are intended to restore these beneficial uses.

Alternatives 2 through 5 would protect the REC-1 and MUN beneficial uses already identified in the Basin Plan and the proposed COMM beneficial use. Alternative 5 would provide the greatest protection to people who consume Delta fish. Because the Alternative 2 objective exceeds the safe methylmercury levels for some wildlife species, Alternative 2 is not fully protective of the WILD beneficial use. Alternatives 3 through 5 fully protect the WILD beneficial use. Under Alternative 1, beneficial uses are protected by the narrative toxicity objective of the Basin Plan. However, the success of the implementation plan for reducing methylmercury in these water bodies may best be evaluated against numeric water quality objectives such as those proposed by Alternatives 2 through 5.

3.2.2 Environmental Characteristics of the Hydrographic Unit

The environmental characteristics and existing conditions of the Delta and tributaries are discussed in Chapters 1 and 2 of this report, respectively. The Delta is used for drinking water, irrigation, contact recreation, stock watering, commercial/sport fishing and habitat for warm and cold-water aquatic species. In addition, the Delta provides a significant fishery and habitat for terrestrial wildlife.

The proposed Basin Plan amendment is designed to improve the water quality of the Delta and tributaries by establishing numeric water quality objectives for methylmercury in fish tissue and defining an implementation plan to meet the objectives. All of the proposed numeric water quality objective alternatives would result in improvements to water quality of the Delta and Delta tributaries. Improvements likely to be reached are described in the next section.

3.2.3 Water Quality Conditions That Could Reasonably Be Achieved

The Basin Plan narrative toxicity objective (Alternative 1, No Action) describes the water quality conditions that should exist in the Delta and tributaries. In order to prepare an implementation plan to achieve these conditions, the narrative objective is translated into numeric objectives. Water quality conditions expected under Alternatives 2 through 5 are discussed below.

Meeting the Alternative 2 proposed water quality objective in fish tissue would allow people to safely eat a moderate amount of fish from a variety of trophic levels in the Delta. Under Alternative 2, humans may eat up to 17.5 g/day of local fish (one meal every two weeks). This assumes the fish eaten from the Delta includes a mixture of TL2 (21.7%), TL3 (45.7%) and TL4 (32.6%) fish. This alternative, however, is not protective of all sensitive fish-eating wildlife species. The safe intake levels recommended by the USFWS for bald eagle and least tern could be exceeded under Alternative 2.

Meeting the Alternative 3 fish tissue objectives would fully protect all sensitive wildlife species and allow people to safely eat a moderate amount of fish from the Delta. Under Alternative 3, consumers may safely eat up to 17.5 g/day of local TL4 fish. This consumption rate assumes that all of the fish eaten will be TL4 species. The Alternative 3 objective is more protective of humans than the Alternative 2 objective because by assuming people eat more of the fish highest in methylmercury (TL4 fish), the average level of methylmercury in these fish must be lower than in Alternative 2.

If the Alternative 4 objectives were attained, people could safely eat large fish at a rate of 32 g/day (one meal per week). This alternative is protective of people who regularly consume an even mixture of locally caught TL3 and 4 fish. The Alternative 4 objectives also fully protect all wildlife species of concern.

The Alternative 5 objective is the lowest fish tissue concentration proposed. If this fish tissue concentration was obtained, people could safely eat TL4 fish at 142.4 g/day (four to five meals per week). Segments of the population consuming locally caught fish as a main source of protein would be protected.

Alternative 2 is currently attained in seven of eight subareas of the Delta. Alternative 3 is currently attained in the Central Delta subarea only. Fish mercury levels in the Central Delta subarea closely approach the Alternative 4 objectives, but more substantial decreases are needed in the other subareas. Alternative 5 is not attained in any of the Delta subareas. The level of reduction required by each alternative depends on the subarea. For example, to meet the Alternative 2 objective for large TL4 fish, methylmercury in fish must decrease by 43% in the Mokelumne/Cosumnes subarea while no reductions are needed in the other subareas. Attaining the Alternative 3 and 4 objectives would require a range of reductions in existing fish tissue concentrations, from little-to-no reduction in the Central Delta to greater than 70% reduction in Mokelumne subarea fish. Alternative 5 would require reductions of 81 to 95% throughout the Delta.

An implementation plan for Alternative 2 would require methylmercury controls only in the Mokelumne/Cosumnes River subarea. Under Alternative 2, then, conditions for humans and wildlife eating fish in the rest of the Delta would not be expected to improve measurably from the existing condition. Although the Alternatives 4 and 5 fish tissue objectives are lower than Alternative 3, the control program needed to achieve the objectives would be essentially the same for all these three alternatives. As described in the TMDL Report (Chapters 3 and 5), the problem with methylmercury in Delta fish can be defined as biotic exposure to methylmercury. Therefore, decreasing biotic exposure to

methylmercury is the ultimate goal of the Delta methylmercury implementation program. Implementation of any of the water quality objective alternatives would focus on actions necessary to reduce methylmercury levels in ambient Delta waters. The alternative implementation strategies for Water Quality Objective Alternatives 3, 4, or 5 would vary in terms of the numbers of individual sources required to characterize and control their methyl and total mercury inputs and/or the magnitude of the percent reductions required for the source inputs.

In general, the lower the objective, the greater the time expected to reach attainment. Concentrations of methylmercury in water and fish are expected to decrease as sediment mercury concentrations decline and methylmercury inputs are controlled. Under an implementation plan to reduce methylmercury production, measurable decreases in fish methylmercury concentrations are expected to occur within three decades after control actions are implemented. Staff expects that relatively substantial decreases that occur soon after implementation will be followed by a long, gradual decline in fish tissue concentrations because any watershed control strategy may need to rely in part on natural erosion to wash out legacy mercury in the Delta's tributary watersheds (see Chapter 4). Actual attainment of the proposed objectives in the Delta could take several hundred years, assuming that legacy and new inputs of mercury are significantly reduced and methylmercury source controls are achieved.

Mercury control programs in other states and countries demonstrate significant reductions in fish methylmercury concentrations after source control. Decades later, however, the levels were still higher than at uncontaminated, comparison sites.[6] In these case studies, controls were directed at total mercury. Inclusion of control programs targeted at reducing methylmercury inputs or curtailing the methylation process is expected to more rapidly reduce methylmercury levels in fish.

3.2.4 Economic Considerations

Implementation of Water Quality Objectives

The economic costs of implementing the proposed Basin Plan amendments are considered in Section 4.2.3.2 and Appendix C. The proposed implementation plan to achieve the proposed fish tissue methylmercury objectives (Section 4.3) relies on the reduction of methyl and total mercury inputs to the Delta. Costs associated with total mercury reduction actions taken to comply with the total mercury limits proposed in Chapter 4 may range from $ to $ (cost analysis is under development). Costs for the proposed methylmercury source characterization and control studies may range from $ to $. Subsequent costs associated with methylmercury control actions are difficult to estimate because, while the proposed Basin Plan amendments explain how the TMDL program will be implemented, they do not yet prescribe the precise long-term actions responsible parties would take to achieve with the proposed methylmercury allocations. Once the proposed characterization and control studies have been completed, the costs associated with the technically feasible methylmercury control technologies and management practices will be evaluated.

[6] See review of mercury cleanup projects in the Cache Creek Watershed Mercury TMDL Report, November 2004 http://www.waterboards.ca.gov/centralvalley/programs/tmdl/Cache-SulphurCreek/CacheNov04a.pdf

Higher fish tissue concentration objectives will take less time to be attained. Despite a difference in time, staff does not expect that costs for reaching the objectives will be significantly different for two reasons.

Costs of implementation plans designed to achieve the Water Quality Objective Alternatives 3, 4, or 5 for would be essentially the same. This is because the Alternative 3 objective is being met in only one subarea of the Delta, and the Alternatives 4 and 5 objectives are not met in any subarea. Hence, reduction strategies and control programs must occur throughout the entire Delta region in order to decrease concentrations of methylmercury in fish tissue to safe levels. Expenses for fish tissue monitoring and public outreach and education will be incurred until the objectives are met; these costs will be less if objectives with higher fish tissue concentrations are selected. The costs for monitoring and outreach are small, relative to costs for construction and maintenance activities to achieve the reductions.

Costs for implementing Water Quality Objective 2 would be significantly lower than costs for the other objective alternatives because reductions would only be needed in one subregion. This alternative is not recommended, though, as it does not protect a variety of sensitive wildlife species.

Importance of Delta Fishery

The Central Valley Water Board is not legally required to provide value of resources as part of the economic considerations. Because information is available on the value of the fishery and the potential costs of mercury intake, however, this information has been summarized below.

The Delta fishery is a valuable resource (see Section 2.3). Although it is difficult to estimate the economic value of the Delta fishery, the Delta Protection Commission produced an economic report for the Delta, in which expenditure estimates were calculated for recreational activities, including fishing, for the local economy in 1994. According to the report, anglers on average spent an estimated 186 million dollars inside the Delta and an estimated 206 million dollars outside of the Delta due to sport-fishing activities in the Delta (Goldman *et al.,* 1998). The worth of Delta fish as a food source, particularly for people who consume local fish because of custom or to supplement their diet, has not been calculated. The California Office of Environmental Health Hazard Assessment has issued an interim fish consumption advisory for the Delta. Although publicity about the advisory may decrease angling in the near term, use of Delta fish as a food resource could seemingly increase as methylmercury levels decline, which would benefit the Delta economy.

Under existing conditions, consumption of Delta fish more than one or two times per month may cause adverse health effects, which accrue a cost in terms of lost income. Mercury is a toxicant that can have lasting effects on the neurological development and abilities of persons exposed *in utero* and as children. Studies of people exposed to methylmercury through consumption of fish by their mothers and/or themselves showed deficits in memory, attention, language, fine motor control and visual-spatial perception that can be translated to decrements in intelligence quotient (IQ) (NRC, 2000; Trasande *et al.,* 2005). The resulting loss of intelligence causes a decrease in income that persists over the lifetimes of the exposed persons. The following two paragraphs describe one method of estimating the lost income.

Staff used national survey data of methylmercury concentrations in blood of women of childbearing age (Mahaffey *et al.*, 2004), the income loss calculation of Trasande and colleagues (2005), and U. S. census data on population and birth rates in six Delta counties in 2000[7] to estimate the loss in earnings to children born each year in the Delta. In year 2000 dollars, the loss in income annually in the Delta is $156 million.[8] Because of uncertainty in the relationship between methylmercury exposure and ultimate effect, the loss could range from $41 to 250 million.[9]

The losses that staff calculated are not estimates of total annual income loss for the Delta because, in any given year, people of multiple ages (birth cohorts) work and earn in the Delta. Rather, the figure represents the lost income for all Delta residents entering the workforce in a single year. To estimate the loss of income during implementation of the mercury strategy, the annual loss of $156 million should be multiplied by the number of years in the implementation period.

3.2.5 Need for Housing

None of the proposed water quality objectives would restrict the development of housing in the Delta. Requirements that address storm water impacts due to new urban development exist under the municipal separate storm sewer system (MS4[10]) permitting program. Municipal MS4 permits include pollution control requirements for developing and implementing a Storm Water Management Plan (SWMP). A SWMP specifies best management practices (BMPs) that will prevent, to the maximum extent practicable, all pollutants from contacting storm water, with the intent of keeping all products of erosion from moving off site into receiving waters; eliminating or reducing nonstorm water discharges to storm sewer systems and other waters of the United States; and performing inspections of all BMPs. The proposed Basin Plan amendments are consistent with these requirements.

3.2.6 Need to Develop and Use Recycled Water

There are no present restrictions on recycling of water due to methylmercury. The intent of this proposed amendment is to improve water quality and reduce methylmercury levels in fish for the Delta region. The proposed objectives, therefore, are consistent with the need to develop and use recycled water. None of the alternatives considered would restrict the development or use of recycled water.

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[7] U.S. census information is available at: http://quickfacts.census.gov/qfd/states/.

[8] Assumptions: 10% of mothers have methylmercury levels in blood that result in decreased IQ of their children; the decreases in IQ cause certain percentage decrease in expected income over lifetime.

[9] Trasande and colleagues (2005) varied the modeling of the dose-effect relationship, the ratio of methylmercury in maternal to fetal blood, and the lowest methylmercury concentration at which impairments were observed in children. The low estimate assumes the combination of variables that produce the least severe effect. The high estimate is the "worst case" combination of variables. All estimates provide cost due to anthropogenic sources of mercury, based on understanding that about 70% of mercury worldwide comes from anthropogenic sources.

[10] A municipal separate storm sewer system (MS4) is a conveyance or system of conveyances that include roads with drainage systems, municipal streets, alleys, catch basins, curbs, gutters, ditches, manmade channels, or storm drains, owned by a State, city, county, town or other public body. MS4s are designed and used for collecting or conveying storm water and do not include combined sewer systems or parts of a publicly owned treatment works. MS4s discharge to waters of the United States. The Municipal Storm Water Permitting Program regulates storm water discharges from MS4s.

3.3 Recommended Alternative

Central Valley Water Board staff recommends the adoption of the Alternative 4 water quality objectives. Alternative 4 would establish Delta objectives of 0.24 and 0.08 mg/kg methylmercury in wet weight fish muscle tissue, as the average concentration in large fish of trophic levels 4 and 3, respectively, and 0.03 mg/kg methylmercury, wet weight, in small whole TL2 and 3 fish less than 50 mm total length. The objectives for large fish were derived to be protective of humans and wildlife in the Delta, including bald eagle, otter, osprey, and peregrine falcon. These proposed objectives would allow humans to safely consume 32 g/day of a mixture of large TL3 and 4 fish, while assuming human consumers eat the national average of 12.5 g/day of commercial fish. The proposed small fish objective would protect the California least tern, a piscivorous species listed by the federal government as endangered and other birds consuming small fish or aquatic invertebrates in the Delta, including herons and rails.

Alternative 4 is recommended for the following reasons:

- It fully protects wildlife species, including threatened and endangered species as required by the Endangered Species Act.
- It reasonably protects humans who eat Delta fish by allowing the consumption of one meal per week of Delta fish. Alternative 4 assumes that over time, individuals will eat an even mixture of large TL3 and 4 fish. Anglers in the Delta commonly target salmon (TL3) and striped bass (TL4), which are reflected in the assumption that a mix of species will be consumed.
- The Alternative 4 large fish objectives are based on a consumption rate greater than the USEPA default rate used in Alternatives 2 and 3. These objectives are therefore more protective of people in the Delta who by custom, need, or enjoyment, frequently eat Delta fish.
- It is consistent with the methylmercury water quality objective recommended by staff of the San Francisco Bay Water Board for San Francisco Bay (SFBRWQCB, 2006). Like the Alternative 4 large fish objectives, the methylmercury objective recommended for the Bay is based on protecting people who eat 32 g/day of local fish. Alternative 4 takes into consideration that humans, piscivorous wildlife and their prey (e.g., anadromous species) travel between the Delta and San Francisco Bay.

Alternative 1 (No action; default to the existing narrative toxicity objective) is not recommended by Central Valley Water Board staff because the default numerical criterion that would apply (USEPA's CTR criterion of 50 ng/l total mercury in the water column) would not sufficiently protect humans and threatened and endangered species that consume fish from the Delta. The CTR criterion was derived using similar factors as the fish tissue alternatives, with an additional factor to relate fish tissue methylmercury concentrations to water total mercury concentrations. This additional factor, termed the practical bioconcentration factor (BCF), is the ratio of mercury concentrations in fish and water. The BCF used for the CTR criterion is 7,342.6 (USEPA, 2000a). In comparison, the BCFs for large TL4 fish and ambient total mercury in the Delta vary by subarea and range between 18,000 and 263,000, and the BCFs for large TL3 fish and ambient total mercury in the Delta range between 6,400 and 81,000. The presence of higher BCFs in the Delta show that a total mercury concentration lower than the CTR criterion would be needed to protect humans and piscivorous wildlife species that consume Delta fish.

Central Valley Water Board staff does not recommend Alternative 2 because it does not fully protect piscivorous wildlife. The Alternative 2 objective of 0.58 mg/kg methylmercury in large TL4 fish is higher than the level estimated to fully protect bald eagle, osprey, river otter, western grebe and other

sensitive wildlife from adverse effects of mercury. The USFWS (2004) commented that 0.58 mg/kg in TL4 fish would not be protective of local wildlife species. Site-specific consumption patterns or information on species' sensitivities to mercury are not available for the Delta. Therefore, the USFWS based their risk assessment on standard, literature values for average consumption by these wildlife species and a careful review of their diets in other parts of California and elsewhere (USEPA, 1995a and 1997; USFWS, 2002; 2003; 2004). Although site-specific consumption information would be preferred, the use of average consumption patterns, sensitivities and body weight data are widely accepted for establishing water quality criteria for mercury and other pollutants to protect humans and wildlife.

Staff does not recommend that the Central Valley Water Board select Alternative 2 or 3 because they are based on a consumption rate for humans from a nationwide dietary survey that may not reflect consumption patterns in the Bay-Delta region. Interviews and surveys conducted by CDHS suggest that many people, particularly in Southeast Asian and African American communities, eat more than 17.5 g/day (one meal every two weeks) of Delta fish (CDHS, 2004; Ujihara, 2006). Although staff took a conservative approach in Alternative 3 by applying the 17.5 g/day rate only to TL4 fish, the national default consumption rate may not be sufficiently protective of Delta consumers.

Staff does not recommend adoption of Alternative 5 at this time. While Alternative 4 likely does not protect people who have the highest rates of consumption of Delta fish, Alternative 5 may not be achievable in the Delta. Because the Alternative 5 objective of 0.05 mg/kg in large TL4 fish is substantially below current conditions, the mathematical relationship between methylmercury in fish and water does not allow accurate prediction of an aqueous concentration that corresponds to this objective. The extrapolation of the methylmercury fish and water relationship using the Alternative 5 objective produces a corresponding aqueous methylmercury concentration that is below the method detection limit. After fish tissue concentrations have been reduced to the recommended Alternative 4 objectives, it is expected that more information will be available to determine water quality objectives and an implementation strategy that may allow greater consumption of Delta fish.

There has been no comprehensive consumption survey for the Delta. Alternative 4 is based on information from the consumption survey conducted in San Francisco Bay (CDHS & SFEI, 2001a) and creel surveys conducted in the Delta (CDFG, 2000-2001). Staff will reevaluate the Delta water quality objectives as necessary to protect Delta-specific consumption patterns. People with high consumption rates should be protected in terms of their methylmercury intake from the Delta even before consumption studies are conducted or methylmercury reductions are achieved. The Basin Plan amendment language proposes that state and local health agencies cooperate to improve education on the risks of eating contaminated fish.

The ultimate goal of the methyl and total mercury control program for the Delta is to reduce methylmercury levels in fish to protect the fish-eating humans and wildlife. As described in the proposed implementation plan in Chapter 4, staff expects that methylmercury concentrations will decrease once implementation actions are undertaken. The proposed implementation plan would require responsible parties to characterize their methylmercury inputs and to determine the most viable and cost efficient methods to control their methylmercury inputs to comply with the proposed methylmercury allocations. Through the application of management practices to curtail the methylation of mercury as well as to control loads of mercury, fish tissue concentrations are expected to show a measurable decrease within a few decades and eventually meet the proposed objectives. However, the length of time needed to reach the goal is uncertain. Therefore, staff recommends the adoption of an implementation program based on

an adaptive management approach that evaluates additional information as it becomes available and incorporates implementation actions accordingly.

3.4 Application of Recommended Alternative to the Basin Plan

The recommended alternative would add Delta-specific numerical water quality objectives to Chapter 3 of the Basin Plan. Adoption of the proposed change would establish water quality objectives for methylmercury in large TL3 fish, large TL4 fish and small TL2/3 fish in the Delta. To facilitate evaluating compliance with the proposed objectives, proposals to amend Chapter 5 of the Basin Plan (Surveillance and Monitoring) include a monitoring program that specifies fish species and sizes within each target trophic level food group (see Chapter 5 in this report). The fish species and sizes used to develop the objectives were derived from sizes of fish locally caught in various sampling programs, and from the life history and prey types of the various species of fish (McGinnis, 1984; Wang, 1986; Moyle, 2004) and piscivorous wildlife (Hamas, 1994; USEPA, 1995a; USEPA, 1997; USFWS, 2002). The Central Valley Water Board will act as the lead agency in developing or reviewing detailed monitoring plans and resources to evaluate compliance with the proposed water quality objectives.

4 PROGRAM OF IMPLEMENTATION

The proposed water quality objectives for methylmercury in Delta fish are being exceeded throughout much of the Delta. Per Porter-Cologne Water Quality Act Section 13050(j)(3), the proposed Basin Plan Amendment must include a program of implementation for the TMDL to bring the Delta into compliance with the proposed objectives in order to protect beneficial uses. Water Code Section 13242 prescribes the necessary contents of an implementation plan, which include: 1) a description of the nature of the actions that are necessary to achieve the water quality objectives; 2) a time schedule; and 3) a monitoring and surveillance program.

This chapter provides an evaluation of implementation alternatives and a recommended suite of actions and timelines to reduce methyl and total mercury sources. Section 4.1 provides a brief description of methyl and inorganic mercury sources to the Delta, the linkage between methylmercury in water and fish tissue, and the ambient methylmercury reductions needed to meet the proposed water quality objective for methylmercury in fish tissue. Section 4.2 includes the alternatives analysis that provides the basis for the program of implementation. Section 4.3 provides a description of the recommended actions to be required of those responsible for maintaining and reducing methyl and total mercury source loads identified in the TMDL and the specific actions the Central Valley Water Board will take to ensure their completion. Also included are various recommendations to the State Water Board and other agencies regarding actions for which the Central Valley Water Board does not have direct authority. The surveillance and monitoring program is described in Chapter 5 of this report.

The implementation plan must ensure that all applicable water quality criteria will be attained and maintained. The applicable water quality criteria consist of: 1) the proposed site-specific methylmercury fish tissue objectives for the protection of wildlife and human health (Chapter 3); 2) the five-year average total mercury load reduction of 110 kg/yr within 20 years to meet the San Francisco Bay Water Board's allocation for the Central Valley to control mercury in San Francisco Bay (Johnson & Looker, 2004); and 3) the California Toxics Rule total mercury water column criterion for the protection of human health (50 μg/l total recoverable mercury; USEPA, 2000a). The TMDL methylmercury allocations are in the form of aqueous (unfiltered) methylmercury in the water column and are specifically correlated and set to attain and maintain the proposed fish tissue methylmercury objectives. In addition, the proposed implementation actions described in this chapter are designed to reduce the amount of total mercury into the Delta to ensure attainment and maintenance of both the San Francisco Bay Water Board's allocation for total mercury loading and the CTR total recoverable water column criterion, as well as the methylmercury fish tissue objectives by reducing the total amount of mercury available for methylation in the aquatic environment. Tables A through G in the proposed Basin Plan amendment language included after the Executive Summary list the recommended methylmercury allocations and total mercury limits for methyl and total mercury sources to the Delta. A detailed description of the methods used to calculate these methylmercury allocations and total mercury limits is provided in Chapter 8 of the TMDL Report.

4.1 Methyl & Total Mercury Sources & Necessary Reductions

This section provides a brief description of methyl and inorganic mercury sources, the linkage between methylmercury in water and fish tissue, and ambient methylmercury reductions needed to meet the proposed water quality objective. The attached TMDL Report contains detailed discussions of each of these topics.

Sources of inorganic mercury in the Delta include tributary inflows from upstream watersheds, atmospheric deposition, urban runoff, dredging activities, and municipal and industrial wastewater. Sources of inorganic mercury in the Delta's tributary watersheds include gold and mercury mine sites, legacy mercury in the stream channel sediments, geothermal springs, atmospheric deposition, urban runoff, and municipal and industrial wastewater. Figure 4.1 illustrates average annual total mercury loading to the Delta during water years[11] (WY) 1984 through 2003, a period that includes a mix of wet and dry years that is statistically similar to what has occurred in the Sacramento Basin over the last 100 years. About 98% of identified total mercury loading to the Delta comes from tributary inputs; within-Delta sources are a very small component of overall loading. The Sacramento Basin (Sacramento River + Yolo Bypass) contributed almost 90% of total mercury fluxing through the Delta. Of the watersheds in the Sacramento Basin, the Cache Creek, Feather River, American River and Putah Creek watersheds had both relatively large mercury loadings and high mercury concentrations in suspended sediment, which makes those watersheds likely candidates for total mercury load reduction programs (see Section 7.1.1 in the TMDL Report).

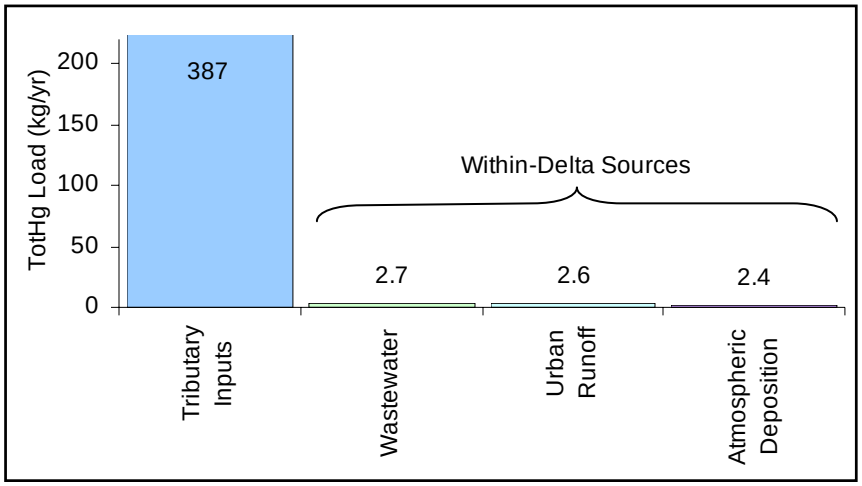

Figure 4.1: Twenty-year Average Annual Total Mercury Inputs to the Delta

The San Francisco Bay mercury control program assigned the Central Valley a five-year average mercury load allocation of 330 kg/yr or a decrease of 110 kg/yr. This represents about a 26% decrease in the 20-year average annual loading from the Sacramento Basin and would enable Delta waters to maintain compliance with the CTR criterion of 50 ng/l (see Section 7.4 in the TMDL Report). Staff has estimated that, if the reduction of inorganic mercury in sediment were the only method used to reduce methylmercury in Delta water and fish, mercury loading to the Delta would need to be reduced by much more than 110 kg/yr.

Sources of methylmercury in Delta waters include tributary inputs from upstream watersheds and within-Delta sources such as sediment flux from wetlands and open water habitats, municipal and industrial

[11] A "water year" (WY) is defined as the period between 1 October and 30 September of the following year; for example, WY2001 is the period between 1 October 2000 and 30 September 2001. Water year types in California are classified according to the natural water production of the major basins. See Appendix E in the TMDL report for more information about water year classifications.

wastewater, agricultural drainage, and urban runoff. Figure 4.2 illustrates the Delta's average annual methylmercury inputs for WY2000 to 2003, a relatively dry period that encompasses the available methylmercury information. Sediment flux from wetland and open water habitats and tributary watersheds accounts for about 30 and 60%, respectively, of methylmercury inputs to the Delta. However, as illustrated in Figure 1.1 in Chapter 1 and described in more detail in the TMDL Report, the methylmercury linkage and source analyses divide the Delta into several subareas based on the hydrologic characteristics and mixing of the source waters. Figure 4.3 shows the contribution of each source category's estimated methylmercury loading to each subarea. A separate methylmercury allocation system is required for each subarea because the levels of fish mercury impairment and the type and amount of the methylmercury inputs to each subarea are substantially different. For example, wetland habitat within the Yolo Bypass may contribute almost as much methylmercury to the subarea as its tributaries, in contrast to the Sacramento and San Joaquin subareas, which receive substantially more annual methylmercury loading from their tributaries.

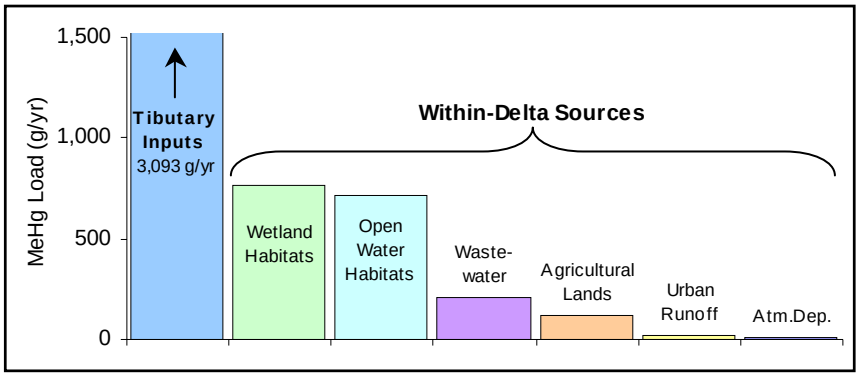

Figure 4.2: Average Annual Methylmercury Inputs to the Delta during WY2000 to 2003

As described in the previous chapter, staff recommends three water quality objectives: 0.24 mg/kg (wet weight) in muscle tissue of large[12] TL4 fish such as bass and catfish; 0.08 mg/kg (wet weight) in muscle tissue of large TL3 fish such as carp and salmon; and 0.03 mg/kg (wet weight) in whole trophic level 2 and 3 fish less than 50 mm in length. The objectives for large TL3 and 4 fish are protective of (a) humans eating 32 g/day (1 meal/week) of commonly consumed, large fish; and (b) all wildlife species that consume large fish. The objective for small TL2 and 3 fish is protective of wildlife species that consume small fish.

A goal of the TMDL program is to link methylmercury concentrations in fish to methylmercury concentrations in water to develop a goal for ambient methylmercury that could then be used to determine source reductions necessary to achieve the water quality objectives for fish. Chapter 5 (Linkage Analysis) of the TMDL Report describes the relationships between methylmercury in ambient water and largemouth bass in the Delta. Largemouth bass was selected for the linkage analysis for several reasons. Largemouth bass was the only species systematically collected near many of the aqueous methylmercury

[12] Large fish are defined as 150-500 mm total length or legal catch length if designated by CDFG.

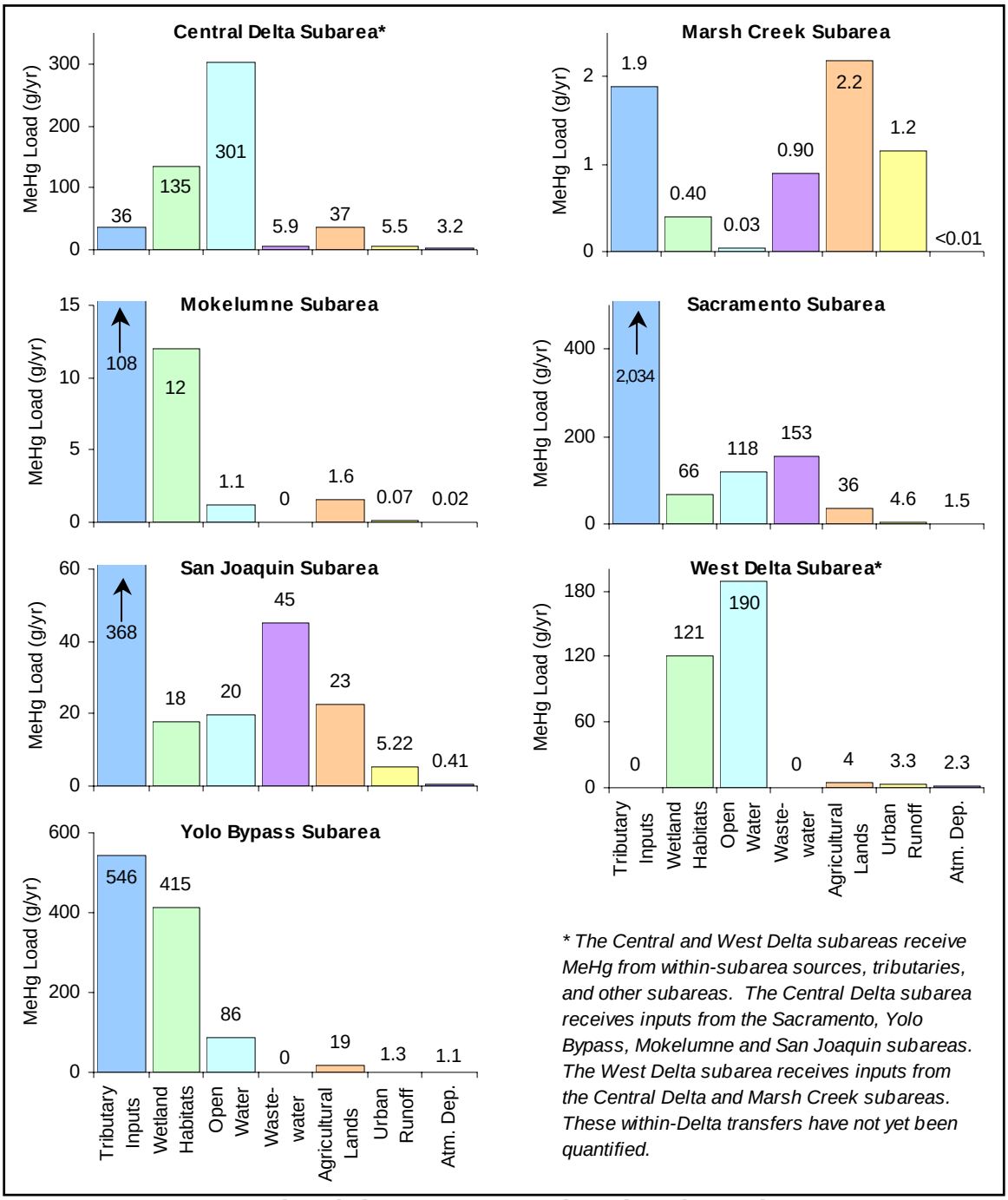

Figure 4.3: Average Annual Methylmercury Inputs to the Delta Subareas during WY2000 to 2003

sampling locations used to develop the TMDL source and linkage analyses. In addition, bass are abundant, are widely distributed throughout the Delta, and have high site fidelity (Davis and Greenfield, 2002), making them useful bioindicators of spatial variation in mercury accumulation in the aquatic food chain. Finally, spatial trends across the Delta in standard 350-mm largemouth bass mercury levels are representative of spatial trends in the trophic level food group mercury levels (see Sections 4.7 and 4.8 in the TMDL Report).

As detailed in Section 4.8 of the TMDL Report, it was possible to describe the proposed water quality objectives for large TL3 and 4 fish and small TL2/3 fish in terms of the mercury concentration in standard 350-mm largemouth bass. As shown in Figure 4.4 below, a methylmercury concentration of 0.28 mg/kg in 350-mm largemouth bass is equivalent to the water quality objective of 0.24 mg/kg for large TL4 fish. A methylmercury concentration of 0.24 mg/kg in 350 mm largemouth bass is equivalent to the water quality objective of 0.08 mg/kg for TL3 fish. A methylmercury concentration of 0.42 mg/kg in 350 mm largemouth bass is equivalent to the water quality objective of 0.03 mg/kg for small fish. As a result, a methylmercury concentration of **0.24 mg/kg in 350 mm largemouth bass** is proposed as the recommended **implementation goal for largemouth bass** throughout the rest of this report.

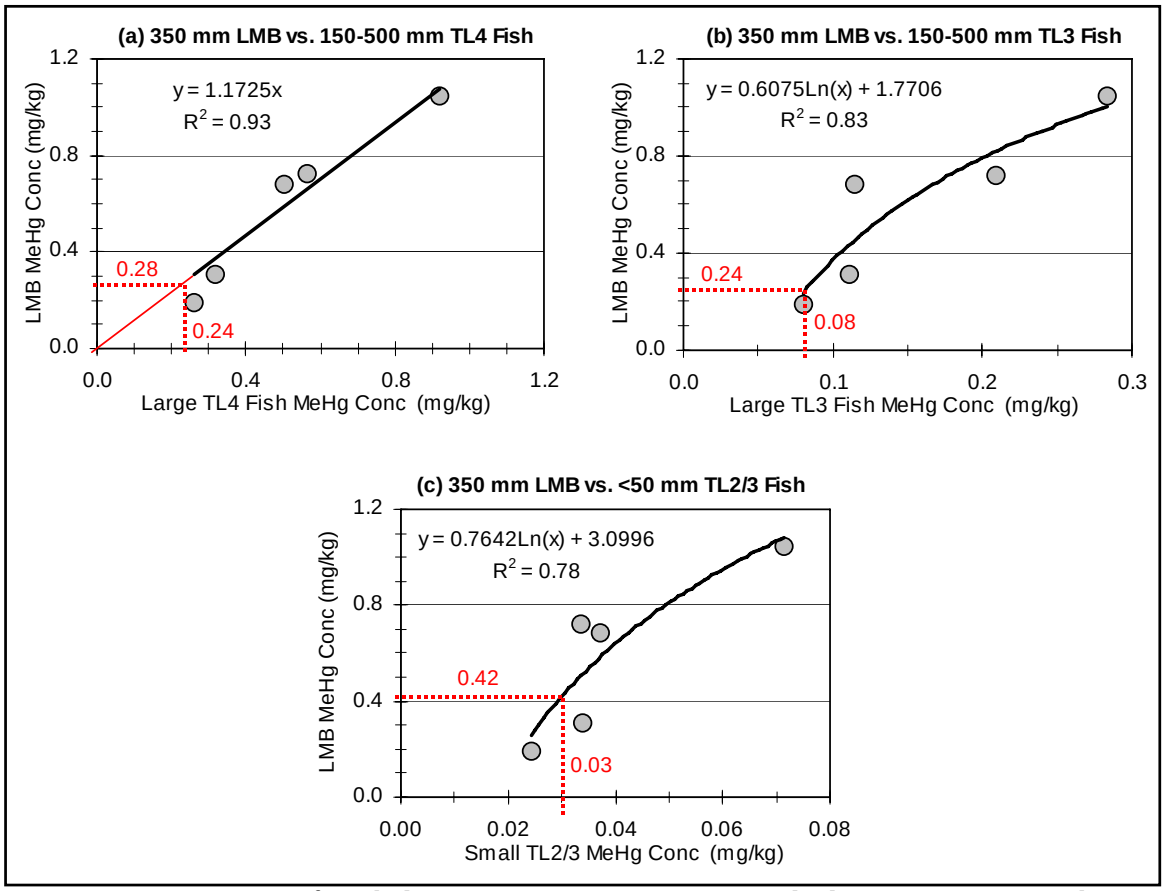

Figure 4.4: Comparison of Methylmercury Concentrations in Standard 350-mm Largemouth Bass (LMB) Caught in September/October 2000 and Composites of Fish Sampled between 1998 and 2001 from (a) 150-500 mm Trophic Level 4 Fish, (b) 150-500 mm Trophic Level 3 Fish and (c) <50 mm Trophic Level 2/3 Fish

Statistically significant, positive correlations have been found between unfiltered aqueous methylmercury and largemouth bass methylmercury. The relationship between methylmercury concentrations in ambient water and standard 350-mm largemouth bass sampled in the Delta is illustrated in Figure 4.5. Substitution of the recommended implementation goal of 0.24 mg/kg methylmercury for largemouth bass into the equation developed by this regression results in a predicted average safe aqueous methylmercury concentration of 0.066 ng/l. Staff recommends the incorporation of an explicit margin of safety of about 10% to develop the recommended **implementation goal for unfiltered ambient water of 0.06 ng/l methylmercury**. The goal would be applied as an annual average methylmercury concentration. This goal describes the assimilative capacity of Delta waters in terms of concentration. It is anticipated that, as the average concentration of methylmercury in each Delta subarea decreases to the implementation goal, the water quality objective for fish tissue will be attained. The aqueous and largemouth bass implementation goals are intended to be used to track progress in meeting the water quality objectives in fish tissue.

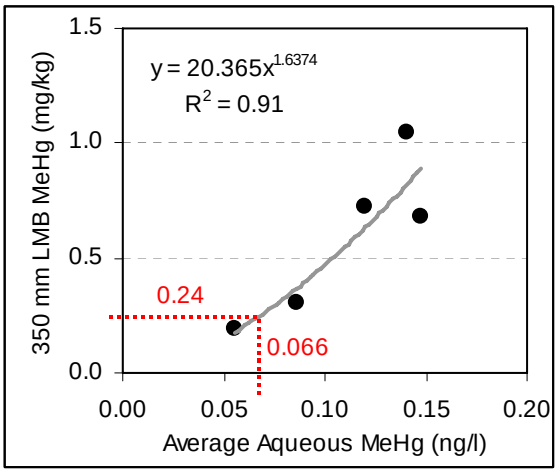

Figure 4.5: Relationship between Methylmercury Levels in Standard 350-mm Largemouth Bass Caught in September/October 2000 and Average Unfiltered Ambient Water Sampled in March-October 2000

Necessary methylmercury source load reductions were calculated in terms of the existing assimilative capacity of the different Delta subareas. The existing average methylmercury concentration of ambient water in each Delta subarea was compared to the implementation goal (Table 4.1). The amount of reduction needed in each subarea is expressed as a percent of the existing concentration. The percent reductions range from 0 to 78% for the different subareas. The percent reductions vary by subarea depending on the level of impairment in each subarea. Because of the varying levels of impairment in the different subareas, and the different sources to each subarea, a separate methylmercury allocation system must be developed for each Delta subarea. For example, the sum of all within-subarea and tributary inputs to the West Delta subarea should be reduced by 28%, while the sum of all within-subarea and tributary inputs to the Yolo Bypass subarea should be reduced by 78%.

Table 4.1: Percent Reductions Needed to Meet the Proposed Implementation Goal of 0.06 ng/l for Methylmercury in Ambient Water.

	Delta Subareas						
	Central Delta	Marsh Creek	Mokelumne River	Sacramento River	San Joaquin River	West Delta	Yolo Bypass
Average Annual Aqueous MeHg Concentrations (ng/l)[(a)]	0.060	0.224	0.166	0.108	0.160	0.083	0.273
Percent Reduction Needed to Meet the Proposed MeHg Goal	0%	73%	64%	44%	63%	28%	78%

(a) Average concentrations are based on unfiltered MeHg concentration data collected March 2000 to April 2005 at the following locations: Delta Mendota Canal and State Water Project (Central Delta); Marsh Creek at Highway 4; Mokelumne River near I-5; Sacramento River at Freeport, River Mile 44 and Greene's Landing; San Joaquin River near Vernalis; outflow to San Francisco Bay measured at X2, usually near Mallard Island (West Delta); and Prospect Slough near Toe Drain (Yolo Bypass). The values for the Central Delta, Mokelumne River, Sacramento River, San Joaquin, West Delta and Yolo Bypass subareas are based on monthly average concentrations so that the average concentrations for each study period are not influenced by the unequal number of samples collected in each month. The sampling frequency on Marsh Creek was inadequate to develop monthly averages; therefore, the average of all available concentration data was used. It was assumed that the sampling locations are representative of the subareas in which they occur.

As noted in Table 4.1, the average methylmercury concentration of ambient water in the Central Delta subarea complies with the proposed implementation goal. As show in Table 2.2, five of six trophic level food group safe mercury levels are met in the Central Delta subarea. The average mercury concentration of large TL4 fish in the Central Delta (0.26 mg/kg) is slightly higher than the proposed objective of 0.24 mg/kg for large TL4 fish. Because Central Delta water quality is dominated by inflows from upstream Delta subareas that require ambient methylmercury reductions ranging from 44 to 78% (Table 4.1), Central Delta TL4 fish tissue mercury concentrations are expected to decrease to safe levels when actions are implemented to reduce up-basin aqueous and fish methylmercury levels.

Alternatives for how to allocate reductions to source categories and individual responsible parties for methyl and inorganic mercury inputs to the Delta and its tributary watersheds are described in the following section.

4.2 Implementation Alternatives Analysis

This report provides an analysis of alternatives and evaluation of potential environmental impacts in accordance with California Environmental Quality Act. Implementation alternatives are described below. Additional environmental analysis is provided in Chapter 7.

An almost infinite number of implementation alternatives are possible. Therefore, staff identified the primary considerations that could substantially guide the implementation program, and developed evaluation criteria. The following is a description of the alternatives analysis process by which the TMDL methylmercury allocations and the program of implementation were developed for the proposed Basin Plan Amendment. The process begins with the identification of evaluation criteria for the implementation considerations and options in Section 4.2.1 and the alternatives in Section 4.2.2.

Evaluation criteria include: likelihood of success; equitability; time needed to observe improvements; the degree to which a given option or alternative can respond or adapt to new data and information; and

consistency with state and federal laws and policies. These criteria are considered throughout the evaluation of the various options and alternatives.

Section 4.2.1 identifies a number of implementation considerations specific to the Delta mercury impairment, evaluates different options for addressing them, and identifies preferred options. In Sections 4.2.2 through 4.2.4, a number of comprehensive alternatives are formulated to address the various options collectively and are then analyzed against the evaluation criteria to select a preferred alternative. Section 4.2.3 presents an analysis of economic and funding considerations as required by CWC Section 13141.

4.2.1 Considerations & Options

Eleven main considerations that are specific to this TMDL and program of implementation were identified during the development of this Basin Plan Amendment. This section presents an explanation of these considerations and identifies options for how to address each of them. Each of the options is preliminarily screened against the evaluation criteria defined in the previous section. If one or more preferred options for addressing a particular consideration are not selected as part of this preliminary screening, then all the options for a particular consideration are carried forward for further evaluation as part of a comprehensive alternative in Section 4.2.3.

Consideration #1: Public Education & Outreach

Recent comprehensive fish monitoring in the Delta has found that several commonly consumed sport fish (largemouth bass, striped bass, Sacramento pikeminnow, channel catfish and white catfish) routinely have tissue concentrations greater than the USEPA criterion of 0.3 mg/kg for protection of human health (Davis *et al*., 2003) and the proposed water quality objectives. Many samples exceed 1.0 mg/kg (wet weight). Until the water quality objectives are attained, the public should continually be informed about safe fish consumption levels. Fish mercury advisories for the Delta were released in the 1970s and 1990s. While a fish advisory will be read by some, it may not reach parts of the population that are at risk of consuming locally-caught fish. Sensitive groups of consumers, such as pregnant women and children, may not catch fish themselves and are less likely to receive the advisory information.

Because fishing is popular in the Delta, a public education program is extremely important. Creel surveys estimate that anglers spend over two million hours per year fishing on the Sacramento River alone (CDFG, 2001). In addition, bass and catfish may be the primary fish kept by anglers throughout much of the Delta (Appendix C in the TMDL Report, Figure C.1). Yet there is low awareness among anglers about fish contamination issues, indicating a need for an expanded and sustained public education and outreach program.

Consideration #1 has two options:

- Option 1(a): Incorporate additional public and education programs.
- Option 1(b): Do not incorporate additional public and education programs.

Central Valley Water Board staff recommends an expanded public education and outreach program (Option 1(a)). Staff recommends that the program coordinate efforts between the State and Regional

Water Boards, Office of Environmental Health Hazard Assessment (OEHHA), California Department of Health Services (CDHS), local county health departments, and dischargers to:

- Evaluate new fish contamination information collected in the Delta and determine whether the present fish advisory for striped bass should be extended to other game fish and shellfish.
- Provide outreach and education regarding the risks of consuming fish containing mercury, emphasizing portions of the population that are at risk, such as pregnant women and children, and instructing people about the sizes and species of fish that may be harmful to consume while highlighting that other less contaminated varieties are an excellent source of protein.
- Conduct regular fish tissue monitoring. Monitoring results would be reported to the Central Valley Water Board and to the public.

Section 4.3.6 provides a more detailed recommendation for an expanded public education and outreach program. A public education component accompanies all of the implementation alternatives discussed in Section 4.2.3, even the "no action" alternative. If the "no action" alternative were adopted, there would be an even greater need for a long-term public outreach program.

Consideration #2: Address Both Methyl & Total Mercury Sources

A direct, positive correlation has been observed between methylmercury concentrations in water and fish tissue in the Delta and elsewhere (refer to Chapter 5 of the TMDL Report). This suggests that aqueous methylmercury concentrations are a major factor influencing methylmercury bioaccumulation in fish. If so, then reducing aqueous concentrations should reduce tissue levels and decrease the environmental hazard posed by consumption of fish with elevated mercury concentrations. The Cache Creek, Bear Creek and Harley Gulch TMDLs and their implementation program were the first to focus source reduction efforts on both methyl and total mercury sources. Other TMDL efforts in California and the United States have focused only on total mercury source reductions. The amount and kind of inorganic mercury present in the sediment are potentially controllable factors important in net methylmercury production. Therefore there are three options to consider:

- Option 2(a): The implementation program focuses on total mercury sources controls only.
- Option 2(b): The implementation program incorporates both methyl and total mercury controls.
- Option 2(c): The implementation program focuses on methylmercury sources controls only.

Millions of kilograms of mercury were released to waterways by historic mining in the Coastal Range and Sierra Nevada. Much remains in Central Valley channels and may be considered untreatable due to environmental and economic factors, thereby necessitating reliance on natural erosion as a reduction strategy. Natural erosional processes may take centuries to wash the mercury from the waterways. Incorporation of methylmercury source controls may reduce the time needed to observe fish tissue improvements from centuries to decades. In addition, if methylmercury sources were not addressed by the implementation program, it is likely that the mercury impairment would become worse as additional wetland restoration, water impoundment, and wastewater treatment plant projects are completed in the Delta and its tributary watersheds. The flexibility to consider both methyl and total mercury implementation measures also may allow more equitable means to address mercury impairment in the Delta.

Alternatively, focusing exclusively on methylmercury sources during Phase 1 of the implementation plan could delay a potentially substantial method of reducing methylation in the Delta: reduction of mercury contaminated sediment entering the Delta from upstream watersheds that may not themselves be large sources of methylmercury to the Delta. As noted earlier, the Feather River and Cache Creek watersheds, among others, export large volumes of highly contaminated sediment. As described in Chapter 3 of the TMDL Report, the amount of inorganic mercury present in the sediment is a factor important in net methylmercury production. In addition, the mercury control program for the Delta must enable compliance with the San Francisco Bay Water Board's total mercury allocation for the Central Valley (a five-year average total mercury load reduction of 110 kg/yr within 20 years) and the USEPA's CTR criterion of 50 ng/l for total mercury in the water column.

Based on this evaluation, Option 2(b) is determined to be the preferred option and will be incorporated into the alternatives analysis in Section 4.2.3. Options 2(a) and 2(c) will receive no further consideration.

Consideration #3: Phased Approach

Consideration must be given to whether enough is known about the methylmercury sources – particularly nonpoint sources – and the control of both point and nonpoint sources such that reasonable and effective allocations can be rationalized. Little published information is available to describe methylmercury levels in discharges from individual sources within each source category. However, results from methylmercury monitoring efforts by 65 municipal WWTPs in the Central Valley indicate that 26 facilities have average effluent methylmercury levels that approach or are less than analytical method detection limits (e.g., less than 0.05 ng/l), 33 facilities have effluent exceeding 0.1 ng/l methylmercury, and seven facilities have effluent exceeding 1 ng/l methylmercury. Ongoing CalFed studies that are evaluating methylmercury discharges from wetlands in the Delta and in Mud and Salt Sloughs in the upper San Joaquin River watershed have found a similar pattern: some wetlands discharge higher methylmercury levels than others. This pattern implies that there may be technologies or management practices able to reduce methylmercury production from some sources. However, more studies are needed to identify the causes of these differences and to develop effective and economically feasible technologies and management practices to control methylmercury production.

Based on uncertainties surrounding our understanding of the various sources, consideration needs to be given to if, and how quickly, to proceed with the TMDL and program of implementation. Therefore, Consideration #3 has the following options:

- Option 3(a): Postpone the inclusion of an implementation program for methylmercury in the Basin Plan until ongoing CalFed studies and other research projects are completed and more information is available. Other considerations related to methylmercury control (Considerations #3, 7,8, 9, 10 and 11) still would be relevant; however, their timing would be delayed.
- Option 3(b): Develop an implementation program based on current understanding of the factors that contribute to methylmercury in the Delta.
- Option 3(c): Proceed with the development of allocations for the various methylmercury sources, but allow further studies to be completed before allocations are enforced. Incorporate a methylmercury study period as "Phase 1" of the implementation program and implement methylmercury control actions during Phase 2 based on the results from ongoing CalFed studies and other studies required under Phase 1. To the extent the efforts to develop methylmercury controls are effective, and/or further scientific information has been collected, subsequent TMDL

revisions (to be addressed by a second basin plan amendment proposed for 2014) would allocate responsibility and control actions to individual point and nonpoint sources. To ensure that studies and other actions of the control program will be performed, a conditional prohibition of discharge will take effect by 31 December 2014.

In order to be consistent with the Clean Water Act and Porter-Cologne Act, a TMDL and program of implementation must be prepared because the Delta has unsafe levels of mercury in fish. The consideration, therefore, is whether or how far to proceed at this time based on the best available science regarding the causes and potential solutions to the impairment. It is possible to be consistent with laws and policies if the best available science is at an appropriate level of development to support a particular option.

The level of science is adequate to proceed with establishing general load allocations, which will drive the execution of further methylmercury characterization and control studies in a phased TMDL implementation program. The current uncertainty surrounding the characterization and control of aqueous methylmercury makes it difficult, however, to implement control actions for all point and nonpoint sources of methylmercury at this time. Therefore, Option 3(c) is the preferred option and will be incorporated into the alternatives analysis in Section 4.2.3.

Consideration #4: Mercury Offset Program

An offset program may be required to accomplish necessary source caps and reductions if it is not technically or economically feasible for some responsible parties to decrease their methyl and/or total mercury loading using on-site load controls. An offset program would allow responsible parties to make off-site source controls *in lieu* of making on-site load controls. Several options are available:

- Option 4(a): No offset program.
- Option 4(b): Develop an offset program for both methyl and total mercury for Central Valley Water Board consideration by 2014, after completion of proposed methylmercury characterization and control studies.
- Option 4(c): Develop a total mercury offset program based on currently available information for Central Valley Water Board consideration by 2009. Develop a methylmercury offset program by 2014 so that it can be guided by the results of the proposed methylmercury characterization and control studies.
- Option 4(d): Develop an offset program for both methyl and total mercury by 2009, before completion of proposed methylmercury characterization and control studies.

As described in Considerations #5 and #6 and later considerations, all methylmercury and almost all total mercury sources are assigned some type of cap or reduction. An offset program would enable such an equitable allocation of responsibility for methyl and total mercury control, while allowing the option to focus reduction efforts on mercury sources with feasible controls if on-site economically or technically feasible controls are not available for some individual sources.

An offset program for total mercury may be necessary to achieve no net increase in total mercury loading in Delta waters from completion of new projects or expansions of existing projects (see Consideration #6). If no technically valid and legally defensible offset program can be developed, then permitted facilities may be required to meet their total mercury caps at the end of their pipes, which could

prove costly while achieving limited environmental benefit. In acknowledgement of the anticipated cost of meeting mercury limits at the end of pipe, several NPDES permits require total mercury offset feasibility studies.

In addition, technically and/or economically feasible on-site methods for reducing all methylmercury sources to the extent necessary to achieve the water quality objectives throughout the Delta may not be possible. If the control studies indicate that adequate onsite control is not feasible for some individual dischargers, then a methylmercury offset program may be necessary.

Option 4(a) is inherently in Alternative 1, the "no action" alternative. Option 4(d), which would allow the offset of methylmercury discharges before the completion of characterization and control studies proposed under Consideration #3, is not forwarded for more evaluation. Staff recommends that methylmercury offset projects not take place until studies are completed that determine which methylmercury sources have economically and technically feasible controls. Adequate information may already exist for developing a total mercury offset program. Hence, Options 4(b) and 4(c) are forwarded for more evaluation.

Considerations #5 & #6: New Sources of Methyl & Total Mercury

Consideration #5: New Sources of Methylmercury. The Delta methylmercury TMDL is based on source information available in 2004 and 2005. New methylmercury sources are those that could increase methylmercury loading to the Delta after Basin Plan amendment adoption and include, but are not limited to, restoration of wetlands, construction of new or enlarged reservoirs, runoff from urban development and other land use changes, changes in water and levee management practices, and new, expanded or modified WWTPs.

To prevent the mercury impairment from back-sliding in the Delta, Central Valley Water Board staff recommends that the Delta mercury control program ensure there is no net increase in methylmercury concentrations in Delta waters above the proposed implementation goal of 0.06 ng/l resulting from the cumulative inputs of new or expanded projects, or changes to existing projects. However, control methods are not yet available so that such a recommendation could be immediately implemented. By the end of 2014, the Central Valley Water Board will have reviewed the results from the proposed methylmercury characterization and control studies and considered effective methylmercury options and the appropriateness of methylmercury offset projects (see Considerations #3 and 4). As a result, the following two options were developed:

- Option 5(a): New projects with discharge methylmercury concentrations less than the implementation goal (or agricultural and wetland return water methylmercury concentrations equal to or less than source water methylmercury concentrations) may be able to contribute methylmercury loading to the Delta without causing ambient methylmercury concentrations to exceed the implementation goal. Parties responsible for new wetland and agricultural projects with return water methylmercury concentrations greater than their source water methylmercury concentrations would need to eliminate or mitigate that portion of the methylmercury loading that causes the exceedance. Other new sources (e.g., new or expanded WWTPs or MS4 discharges) with discharge methylmercury concentrations greater than the implementation goal would need to

mitigate that portion of their loading that increases their discharge concentrations above the implementation goal.[13] New projects completed between the amendment adoption date and 2014 would be considered in compliance with the Delta mercury control program if their responsible parties participate in the source characterization and control studies described under Consideration #3 and submit a methylmercury control plan to the Central Valley Water Board at the completion of the studies. Depending on the magnitude of new sources that begin before 2014, the allocations adopted for this amendment may need to be adjusted to accommodate any resulting increase in ambient methylmercury concentrations.

- Option 5(b): Reduce existing methylmercury sources by a greater percentage to reserve assimilative capacity for new sources, including sources with discharge methylmercury concentrations greater than the proposed implementation goal. Once that reserve is exhausted, new sources with discharge methylmercury concentrations greater than the implementation goal would need to mitigate that portion of their loading that increases their discharge concentrations above the implementation goal.

There is substantial uncertainty in the loading estimates for existing point and nonpoint methylmercury sources, and little is known about methylmercury control methods for either point or nonpoint sources. At this time it is not known which types of sources would be the most feasible to control. As a result of these factors, the decision to reduce loads from some existing source categories while allowing new projects to increase methylmercury loading would be based solely on a subjective evaluation of which projects are more valuable to the citizens of California. Therefore, only Option 5(a) was forwarded to the alternatives analysis.

Consideration #6: New Sources of Total Mercury. New total mercury sources are those that increase total mercury loading to the Delta after the amendment adoption date and may include, but are not limited to, runoff from urban development and other land use changes, changes in water and levee management practices, and new, expanded or modified WWTPs. Any new total mercury input to the Delta and its tributary watersheds has the potential to be methylated in the Delta, its tributaries, or the San Francisco Bay. In addition, the Delta mercury implementation program must decrease loading from the Delta to the San Francisco Bay to comply with Region 2's proposed total mercury load allocation for Central Valley outflows to the Bay. Therefore, total mercury loading to the Delta must not be increased.

However, anticipated population growth and regional hydrologic changes that may result from global climate changes could result in increases in total mercury loading for which on-site load controls are not technically or economically feasible. As a result, two options were developed for accomplishing no net increase in total mercury loading to the Delta:

- Option 6(a): Limit total mercury sources to average annual loads observed at the time a total mercury offset program is considered for adoption by the Central Valley Water Board. (Board

[13] Because of the concentration and amount of their discharge relative to the receiving water and other factors, existing individual sources (e.g., a single facility outfall, MS4 outfall or wetland) may or may not result in a measurable increase in the methylmercury concentration of downstream Delta waters. However, the sum of such source loads results in measurable increases in fish mercury levels. The same is expected to be true of new methylmercury sources. For this reason, staff recommends that parties responsible for new sources such as irrigated agricultural lands and wetlands mitigate any increase observed between source and return water methylmercury concentrations, and that other new sources mitigate that portion of their loading that increases their discharge concentrations above the implementation goal of 0.06 ng/l.

review of a total mercury offset program is expected in either 2009 or 2014; see Consideration #4.) Require that new or expanded projects completed after that date do not result in a net increase in total mercury loading to the Delta. If a new project causes increased loading to the Delta, the increased load must be mitigated. Depending on the magnitude of new sources, the total mercury limits adopted by this amendment may need to be adjusted to accommodate any resulting increase in total mercury loading.

- Option 6(b): Reduce currently existing total mercury sources to allow for discharges from new sources that begin discharging after the adoption of this amendment. Once that reserve is exhausted, new sources would need to be mitigated.

As with Consideration #5 for new methylmercury sources, the decision to reduce loads from some existing total mercury sources while allowing some new projects to increase loading without mitigation would be based solely on a subjective evaluation of which projects are more valuable to the citizens of California. Therefore, only Option 6(a) was forwarded to the alternatives analysis.

Considerations #7 through #12: Apportioning Source Control Responsibility for Existing Sources

Considerations #7 through #12 address several questions critical to the apportioning of responsibility for studying, controlling and reducing the variety of existing methyl and total mercury sources:

- Should the implementation plan focus on only within-Delta methyl and total mercury sources, or should the implementation also address upstream sources?
- Should load reduction efforts focus on methyl and total mercury source categories that contribute the most loading or should reduction efforts be required of all sources?
- Should load reduction efforts focus on the individual methylmercury sources within each source category that have discharges with high methylmercury concentrations or loads or should all individual sources be reduced?
- Should all responsible parties be required to complete methylmercury characterization and control studies?

The following paragraphs outline options that address each of these questions.

Consideration #7: Address Upstream Sources or Only Within-Delta Sources. There are numerous point and nonpoint sources of methyl and total mercury just outside the legal Delta boundary in the Delta's tributary watersheds. The Delta implementation plan could focus only on within-Delta sources or it could expand to include upstream sources:

- Option 7(a): Address only within-Delta sources of methyl and total mercury with the Delta implementation program and delay the inclusion of sources in the tributary inputs to future amendments for the TMDL programs for the upstream 303(d) listed waterways.
- Option 7(b): Address within-Delta sources of methyl and total mercury, total mercury sources in the tributary watersheds downstream of major dams, and methylmercury sources within 30 miles of the Delta (Figure 4.6) within the Central Valley.
- Option 7(c): Address both methyl and total mercury sources in the Delta and its tributary watersheds downstream of major dams.

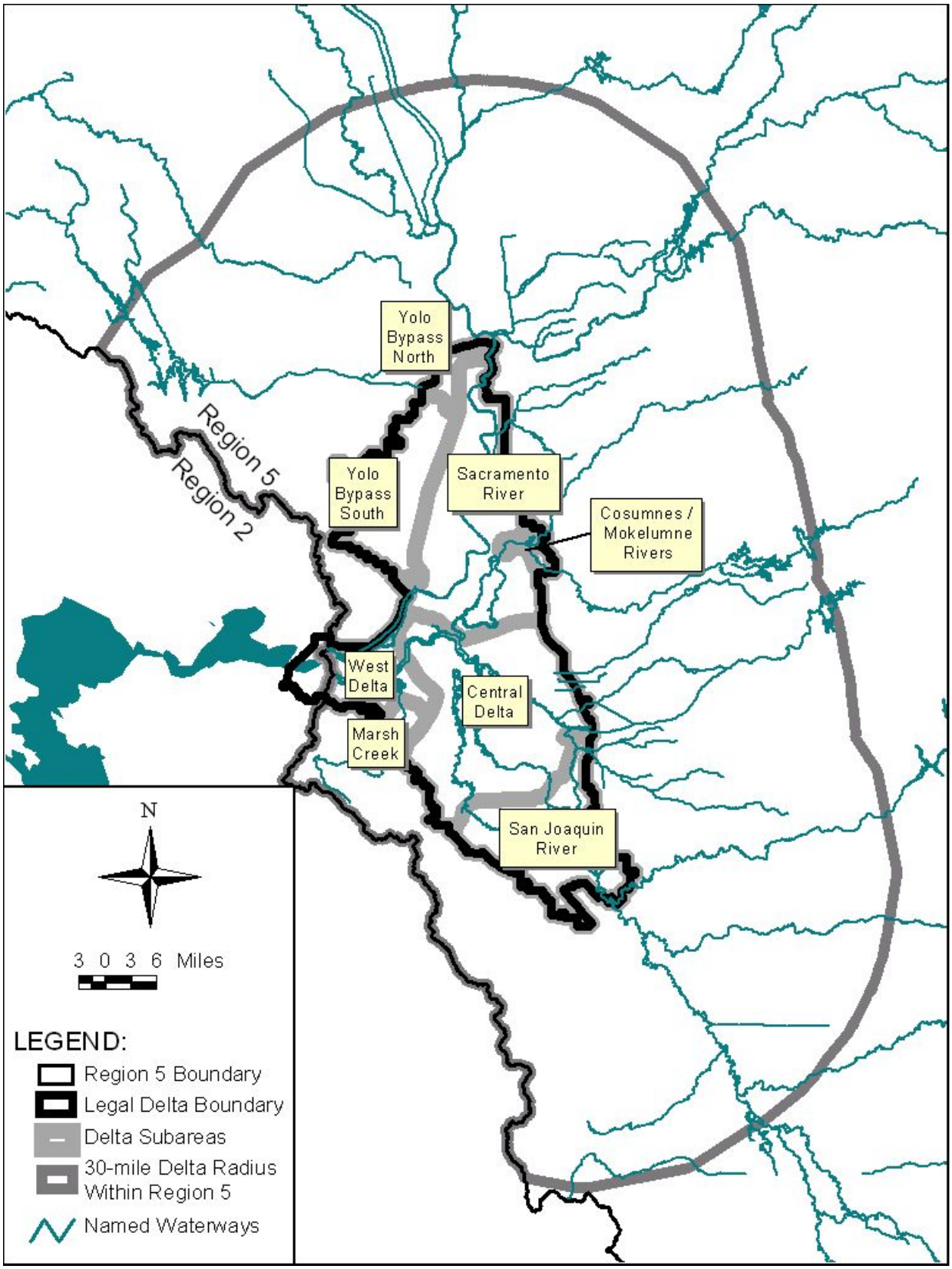

Figure 4.6: Legal Delta Boundary and Tributary Areas within 30 Miles

More than 96% of total mercury loading and about 63% of methylmercury loading comes from tributary inputs. Achievement of the proposed water quality objectives in the Delta will rely on reducing upstream sources. In addition, there is a need for a control program that is consistent in addressing NPDES permits within and adjacent to the Delta. For example, applying different regulations to a given MS4 service area split by the legal Delta boundary would be ineffective and difficult to implement. Therefore, it would be more efficient to implement controls on both within-Delta and upstream sources as part of the Delta implementation plan, to the extent justified by available information. Staff recommends that load reductions required to meet the proposed water quality objectives for Delta fish be considered minimum requirements for the upstream waterways. Additional load reductions could be required to meet future tributary-specific water quality objectives as needed upon completion of their TMDLs.
Dams on the major tributaries[14] act as controls on water volumes and total mercury loading from the upper watersheds. It is expected that total mercury discharged downstream of dams eventually will be transported to the Delta. Hence the recommendation in both Options 7(b) and 7(c) that the Delta implementation program address total mercury sources downstream of major dams.

Less is known about the transport and subsequent conservation of methylmercury discharged by sources in the tributary watersheds. For example, methylmercury in waters discharged by Shasta Dam about 250 miles upstream of the Delta may undergo several transformations in the waters' week-long journey to the Delta. A 30-mile scope may be more appropriate. A 30-mile scope encompasses the major MS4 service areas that have discharge points adjacent to or within the Delta. In addition, 30 miles represents approximately 1-day travel time by water on the main rivers. Preliminary study results for the Sacramento River near Rio Vista indicate relative surface water photodegradation rates of about 30% of the dissolved methylmercury per day at the top half meter of water (Byington *et al*., 2005; see Chapter 6 in the TMDL Report). Hence, while some portion of any given methylmercury discharge within a day's travel time of the Delta may degrade before reaching the Delta, a substantial portion is expected to directly contribute to the Delta. As a result of these factors, only Option 7(b) is carried into the alternatives evaluation.

Consideration #8: Responsibility Apportioned to Total Mercury Source Categories.
About 30% of the methylmercury in the Delta is produced locally in sediment (Figure 4.2). Methylmercury production is a positive linear function of the inorganic mercury content of sediment; mercury load reductions elsewhere have resulted in decreases in fish tissue methylmercury concentrations (see Chapter 3 in the TMDL Report). Inorganic mercury source categories include: tributary inputs; municipal and industrial wastewater treatment plants; urban runoff; dredging; flood conveyance; and air emissions. As noted earlier, the Cache Creek, Feather River, American River and Putah Creek watersheds in the Sacramento Basin export the largest volumes of highly contaminated sediment. The San Francisco Bay mercury control program assigned the Central Valley a five-year average mercury load allocation of 330 kg/yr or a decrease of 110 kg/yr. This represents about a 28% decrease in the 20-year average annual loading from the Delta tributaries and would enable Delta waters to maintain compliance with the CTR criterion of 50 ng/l (see Section 7.4 in the TMDL Report). A 110 kg reduction in total mercury from the Sacramento Basin is a reasonable goal for the first phase of the Delta mercury control program because staff has estimated that, if the reduction of inorganic mercury in sediment were the only

[14] Major reservoirs and lakes in the Sacramento Basin include Shasta, Whiskeytown, Oroville, Englebright, Camp Far West, Folsom/Natoma, and Black Butte, Indian Valley, Clear Lake and Lake Berryessa. Major reservoirs and lakes in the San Joaquin Basin include Camanche, New Hogan, New Melones/Tulloch, Don Pedro, McClure, Burns, Bear, Owens, Eastman, Hensley, Millerton and Marsh Creek.

method used to reduce methylmercury in Delta water and fish, mercury loading to the Delta would need to be reduced by substantially more than 110 kg/yr (see Section 8.2 in the TMDL Report).

Two options are possible for apportioning responsibility for source control to the different total mercury source categories:

- Option 8(a): Focus total mercury load reduction efforts on nonpoint sources in the tributary watersheds that export the most mercury-contaminated sediment and cap all other point and nonpoint sources in the Delta and its source region to reduce overall total mercury loading to the Delta by 110 kg/yr.
- Option 8(b): Reduce all total mercury source categories equally by the amount needed to reduce overall total mercury loading to the Delta by 110 kg/yr.

It would be most equitable to reduce all total mercury point and nonpoint source categories in the Delta and its source region by equal percentages to achieve an overall reduction of 110 kg/yr to comply with the San Francisco Bay Water Board's mercury control program. Reduction efforts for point source categories are the most likely to succeed within a timely period. However, the total mercury source analysis provided in the TMDL Report indicates that almost all the total mercury loading to the Delta comes from tributary inputs. NPDES facilities and MS4s in the Delta contribute only about 2% of the total mercury load to the Delta, and upstream NPDES permitted discharges are expected to contribute a similar small percentage to the tributary loads. Therefore, focusing reduction efforts on upstream nonpoint sources would make the implementation program more likely to succeed in measurably reducing Delta fish mercury levels. However, development and implementation of nonpoint source management practices has traditionally proved difficult in California. Also, the relative bioavailability of mercury in point source discharges remains unknown. Based on these contrasting factors, both Options 8(a) and 8(b) are carried into the alternatives evaluation.

Consideration #9: Responsibility Apportioned to Methylmercury Source Categories.
Methylmercury source categories include: tributary inputs; municipal and industrial wastewater treatment plants; MS4s; dredging; native and managed wetlands; flood conveyance; water management; and agriculture. Some of these categories include nonload-based factors that affect aqueous methylmercury levels in the Delta, such as:

- Increased methylation discharges from Yolo Bypass habitats resulting from flood conveyance flows;
- Potentially increased methylation rates in the Delta resulting from exposure of sediments with relatively high total mercury concentrations by dredging activities; and
- Potentially increased methylation rates in the Delta resulting from future changes in water storage, water delivery to, or diversions from, the Delta, or future changes to salinity standards or flow management practices used to maintain current salinity standards.

Although these are factors that may affect aqueous methylmercury levels in the Delta, they do not have discharges of methylmercury for which allocations can be made. The Delta implementation plan could focus only on load-based methylmercury sources or it also could address nonload-based factors. A variety of options are possible for apportioning responsibility for source control to the different methylmercury source categories:

- Option 9(a): Reduce only load-based methylmercury sources (e.g., wastewater treatment plants, urban runoff, and agricultural return water) by the amount needed to achieve the implementation

goal for aqueous methylmercury in each Delta subarea. Do not address nonload-based factors. This option would rely upon allocations being implemented through utilization of Central Valley Water Board authority to issue NPDES permits, WDRs, and other means of controlling surface water discharges.

- Option 9(b): Reduce the load-based methylmercury sources by the amount needed to achieve the implementation goal for aqueous methylmercury in each Delta subarea, characterize and cap existing nonload-based factors, and require mitigation for impacts caused by future changes to nonload-based factors. This option would rely upon development of inter-agency agreements to ensure that existing impacts of these nonload related factors are properly characterized. In addition, this option would rely upon utilization of 401-certification authority over future watershed projects, coordination with SWRCB authority over water rights, and other inter-agency agreements and measures to ensure that future impacts of these nonload related factors are identified and either reduced or mitigated.
- Option 9(c): Reduce all methylmercury source categories by the amount needed to achieve the implementation goal for aqueous methylmercury in each Delta subarea. This option would rely upon utilization of 401-certification authority over future watershed projects, coordination with SWRCB authority over water rights, and other inter-agency agreements and measures to ensure that existing and future impacts of these nonload related factors are properly characterized and either reduced or mitigated.
- Option 9(d): Focus methylmercury load reduction efforts on source categories in the Delta and within 30 miles upstream of the Delta that contribute the most methylmercury loading to the Delta and cap all other source categories.
- Option 9(e): Reduce all methylmercury source categories to the maximum extent practicable using best available technologies and management practices.

One of the challenges in developing an equitable and effective solution to the Delta mercury impairment is that the Central Valley Water Board has limited regulatory authority to require control of the impacts caused by nonload-based factors. The resulting consideration is whether or not, and how, to account for the effect of nonload related contributing factors. TMDL regulations and guidance are focused on controlling discharges of pollutants as the means of addressing water quality impairments and do not clearly address how contributing nonload-based factors should be controlled. However, addressing the impact of nonload related factors in a TMDL and implementing control actions are consistent with applicable laws or regulations as long as such actions are within Central Valley Water Board jurisdiction. In fact, the Central Valley Water Board Watershed Policy supports focusing implementation efforts on the most important problems and those sources contributing most significantly to those problems.

Options 9(b) and (c) are consistent with the proposed requirement of no net increase in methylmercury concentrations above 0.06 ng/l in Delta waters due to new or expanded projects. Option 9(c) is more equitable than Options 9(a) and 9(b) because it accounts for the real impact of nonload related factors on existing conditions in the Delta, rather than placing the burden entirely on load-based sources. There is also a degree of increased flexibility and likelihood of success associated with having more causes and potential solutions to the problem being considered. However, because of the complexity of the nonload based sources and because the Central Valley Water Board has limited jurisdiction over nonload related factors, there is some uncertainty about whether the impact of these factors can be addressed in a timely manner. Therefore, all three options will be forwarded for further evaluation as part of comprehensive alternatives in Section 4.2.3.

Nonpoint source categories may comprise a much larger portion of methylmercury to some subareas of the Delta than point source categories, leading to the consideration of Option 9(d). However, each source category is comprised of a myriad of smaller individual sources, each with its own intrinsic value and financial constraints. As noted earlier, load reduction strategies must balance equitability, time to implement improvements, likelihood of success, and flexibility. As with the total mercury source categories discussed under Consideration #8, it would be most equitable to reduce all methylmercury point and nonpoint source categories in the Delta and within 30 miles of the Delta by equal percentages required to achieve the proposed WQO in every Delta subarea.[15] The provisional load estimates suggest that reducing or eliminating any one source is unlikely to be a major factor in controlling ambient methylmercury concentrations in the Delta. However, there is substantial uncertainty in the loading estimates for point and nonpoint methylmercury sources, and little is known about methylmercury control methods for either point or nonpoint sources. At this time little is known about which within-Delta and tributary sources would be the most feasible to control. As a result of these factors, the decision to reduce loads from some source categories while allowing others to stay the same would be based solely on a subjective evaluation of which projects are more valuable to the citizens of California. Based on these factors, Option 9(d) is not carried into the alternatives evaluation.

In keeping with the desire for equitability, Option 9(e) also will not be carried into the alternatives evaluation *at this time.* If future proposed studies are unable to develop effective control measures for some methylmercury source categories, then to compensate, other sources may be required to reduce their loads to the maximum extent practicable using best available technologies and management practices as part of future phases of the implementation program.

Consideration #10: Responsibility Apportioned to Individual Sources within Each Methylmercury Source Category. Results from methylmercury monitoring by NPDES facilities in the Central Valley indicate that many facilities have average effluent methylmercury levels that approach or are less than the proposed implementation goal for unfiltered methylmercury in Delta waters (0.06 ng/l), while other facilities have much higher methylmercury levels (see Chapter 6 and Appendix G in the TMDL Report). This implies that some discharges, though they contribute methylmercury loading to the Delta, may act as dilution because of their low methylmercury concentrations. Ongoing CalFed studies that are evaluating aqueous and fish methylmercury levels in wetlands in the Yolo Bypass and the San Joaquin River watershed have found a similar pattern: some wetlands have higher methylmercury levels than others (C. Foe and D. Slotton, personal communications). It is expected that technologies or management practices able to reduce methylmercury production from some sources may be developed based on the understanding of such differences.

Staff recommends that individual sources that discharge methylmercury concentrations above the proposed implementation goal be required to cap or reduce loads as needed to accomplish the proposed implementation goal in Delta waters. Because of the amount of their discharge relative to the receiving

[15] As described in Section 4.2.1, different amounts of source reduction are needed in the different Delta subareas because the existing average ambient methylmercury levels in each Delta subarea are different. The average ambient methylmercury levels in the Central Delta already achieve the proposed implementation goal for methylmercury in ambient water (0.06 ng/l), while the peripheral subareas require percent reductions ranging from 28 to 78% for their ambient water to achieve the proposed implementation goal (see Chapter 8 in the TMDL Report). Although different amounts of source reduction will be needed for each Delta subarea, the implementation program must have a consistent strategy for addressing the different source categories and individual discharges that contribute methylmercury to each Delta subarea and its tributaries.

water and other factors, these sources may or may not result in a measurable increase in the methylmercury concentration of downstream Delta waters. However, the sum of such source loads results in measurable impairment in Delta fish. For this reason, staff recommends that individual sources with concentrations above the proposed implementation goal be controlled.

As a result, four discharge/receiving water scenarios exist. These are highlighted by the matrix in Table 4.2. Below are the recommended allocation strategies for each scenario that would enable no net increase in ambient methylmercury concentrations above 0.06 ng/l even if the source discharge volumes increase, so long as the allocations for each individual source methylmercury concentration and load are maintained:

I. Sources that have average annual discharge methylmercury concentrations less than the implementation goal of 0.06 ng/l that discharge to waterways achieving the proposed implementation goal (e.g., waters in the Central Delta) would have their average discharge methylmercury concentrations capped. Discharge volumes and loads from such sources would be allowed to increase so long as their average methylmercury concentrations do not increase.

II. Sources that have average annual discharge methylmercury concentrations greater than the implementation goal that discharge to waterways achieving the proposed implementation goal (e.g., waters in the Central Delta) would have their discharge methylmercury concentration and load capped. Discharge volumes from such sources would be allowed to increase so long as their allocated load and concentration do not increase. For example, an increase in volume would necessitate a decrease in methylmercury concentration to maintain the load allocation so that the increased volume does not cause an increase in receiving water methylmercury concentration.

III. Sources that have average annual discharge methylmercury concentrations less than the implementation goal that discharge to waterways with ambient methylmercury concentrations greater than the implementation goal (e.g., the Yolo Bypass subarea, which requires nearly a 80% reduction in ambient methylmercury levels to achieve the proposed implementation goal) would have their discharge methylmercury concentration capped. Discharge volumes and loads from such sources would be allowed to increase so long as their methylmercury concentrations do not increase because increasing volumes from such sources would increase dilution to the impaired receiving water.

IV. Sources that have average annual discharge methylmercury concentrations greater than the implementation goal that discharge to waterways with ambient methylmercury concentrations greater than the implementation goal (e.g., the Yolo Bypass subarea) would be required to reduce their discharge methylmercury concentration and load by the amount needed to achieve the proposed implementation goal in the Delta receiving water. Discharge volume would be allowed to increase so long as the allocated load (after allocation is achieved) does not increase. For example, an increase in volume would necessitate a decrease in methylmercury concentration to maintain the load allocation so that the increased volume does not cause an increase in receiving water methylmercury concentration.

If individual sources increase their discharge volume without maintaining these allocations, the associated increase in methylmercury loading must be mitigated.

Table 4.2: Matrix Summarizing Responsibility Apportioned to Individual Sources within Each Methylmercury Source Category for Different Scenarios.

4 SCENARIOS [a]		Individual Source Discharge Average Annual MeHg Concentration	
		Less Than Implementation Goal	Greater Than Implementation Goal
Receiving Water Average Annual MeHg Concentration [b]	Less Than 0.06 ng/l	I. Cap Source Discharge MeHg Concentration	II. Cap Source Discharge MeHg Concentration & Load
	Greater Than 0.06 ng/l	III. Cap Source MeHg Concentration	IV. Reduce Source MeHg Concentration & Load by Amount Needed to Achieve Implementation Goal in Receiving Water

(a) Responsibility is apportioned such that if individual sources increase their discharge volumes while achieving these allocations, no net increase in ambient methylmercury concentrations above 0.06 ng/l would occur. If individual sources increase their volume without maintaining these allocations, the corresponding increase in methylmercury loading must be mitigated.

(b) Average methylmercury concentrations in the Central Delta waters achieve the proposed implementation goal; therefore, the Central Delta is not considered impaired for implementation planning purposes. Average fish and water methylmercury concentrations in the other Delta subareas are higher than the proposed water quality objective and implementation goal.

A couple of options are possible for apportioning responsibility for source reductions to the individual responsible parties of sources within Scenario IV that are required to reduce their methylmercury concentrations and loads:

- Option 10(a): Cap sources with relatively small loads and focus reduction efforts on the sources with relatively high methylmercury loads.
- Option 10(b): Reduce all individual methylmercury sources equally.

Both of these options are forwarded to the alternatives analysis.

Consideration #11: Responsibility for Studies. Source characterization and control studies require substantial effort and funds. Staff recommends that responsible parties within each source category that occurs in the Delta or within 30 miles of the Delta conduct collaborative studies to enable cost savings and increase the likelihood of useful study results. However, there are a couple options for how responsibility can be assigned to responsible parties for individual sources within each source category:

- Option 11(a): Responsible parties within each source category that have the largest volumes of discharge within each category take the lead and conduct the studies. For example, MS4s serving smaller municipalities (<100,000 people)[16] and small WWTPs (<1 mgd) would not be required to

[16] MS4 permits were issued in two phases. Under "Phase I", which started in 1990, the Regional Water Boards have adopted NPDES storm water permits for medium (serving between 100,000 and 250,000 people) and large (serving greater than 250,000 people) municipalities. Most of these permits are issued to a group of co-permittees encompassing an entire

conduct studies. These smaller dischargers would be required to allow access for sampling by those implementing the studies. Both large and small dischargers may be required to implement feasible control technologies and management practices once developed. Similar criteria (e.g., acreage) would be developed for individual agricultural and wetland sources once the responsible parties have been identified during the beginning of Phase 1 of the implementation plan.

- Option 11(b): All responsible parties provide funding for and participate in the studies.

All methylmercury sources, regardless of size, contribute to the mercury impairment in the Delta. In addition, the discharge volume of the individual sources may not be the primary factor that determines discharge methylmercury concentrations. Therefore, it would be most equitable if all responsible parties contributed funding to the studies. However, many of the small dischargers are more limited by financial constraints. Both of these options are forwarded to the alternatives analysis.

4.2.2 Implementation Alternatives Considered

In this section, four alternatives are formulated from different combinations of the options described in Section 4.2.1 (Table 4.3). The progression of the alternatives generally represents increasing levels of effort to a greater number of responsible parties. All of the implementation alternatives, including the "No Action" alternative, will incorporate outreach to educate the public regarding the levels of fish consumption that may cause adverse health effects (Option 1a in Section 4.2.1). In addition, regular reporting to the Central Valley Water Board regarding progress toward meeting the proposed water quality objective is proposed for all alternatives. Under each implementation alternative, the Central Valley Water Board will review progress toward meeting the water quality objective and load allocations every five years. For each five-year review, staff will evaluate recent scientific information regarding methyl and total mercury reductions to determine if changes are required for the implementation program, incorporating an adaptive management approach.

The first alternative, the "No Action" alternative would require no active methyl or total mercury control actions. The other three alternatives require some level of action. As described in Section 4.2.1 and Table 4.3, they have several options in common:

- Option 2(b): Incorporate both methyl and total mercury controls in the implementation program.

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metropolitan area. These permits are reissued as the permits expire. As part of Phase II, the State Water Board adopted a General Permit for the discharge of storm water from small MS4s (WQ Order No. 2003-0005-DWQ, NPDES No. CAS000004) to provide permit coverage for smaller municipalities, including non-traditional small MS4s, which are governmental facilities such as military bases, public campuses, and prison and hospital complexes. Phases I and II of the Municipal Storm Water Permitting Program should not to be confused with Phases I and II of the Delta mercury program discussed in this document.

Table 4.3: Implementation Alternatives

OPTIONS		ALTERNATIVES [a]			
		1	2	3	4
1(a)	Incorporate expanded public education and outreach programs.	X	X	X	X
2(b)	Incorporate both methyl and total mercury controls.		X	X	X
3(c)	Incorporate MeHg study period in implementation plan.		X	X	X
4(a)	No mercury offset program.	X			
4(b)	Develop TotHg and MeHg offset program by 2014, when MeHg source & characterization studies are completed.		X		
4(c)	Develop TotHg offset program by 2009 & MeHg offset program by 2014.			X	X
5(a)	No net increase in Delta ambient MeHg concentrations above 0.06 ng/l resulting from the cumulative inputs of new or expanded projects completed after 2014.		X	X	X
6(a)	No net increase in TotHg loading to the Delta.		X	X	X
7(b)	Address within-Delta sources of methyl and total mercury, total mercury sources in the tributary watersheds downstream of major dams, and methylmercury sources within 30 miles of the Delta.		X	X	X
8(a)	Focus total mercury load reduction efforts on nonpoint sources in the tributary watersheds that export the most mercury-contaminated sediment and cap all other point and nonpoint sources in the Delta and its source region to reduce overall total mercury loading to the Delta by 110 kg/yr.		X	X	
8(b)	Reduce all total mercury source categories equally by the amount needed to reduce overall total mercury loading to the Delta by 110 kg/yr.				X
9(a)	Reduce load-based MeHg source categories by the amount needed to achieve the implementation goal for aqueous methylmercury in each Delta subarea. Do not address nonload-based factors such as flood conveyance and other water management activities.		X		
9(b)	Reduce load-based MeHg source categories by the amount needed to achieve the implementation goal for aqueous methylmercury in each Delta subarea, characterize existing nonload-based factors, and mitigate impacts caused by future changes to these factors.			X	
9(c)	Reduce both MeHg load-based sources and nonload-based factors by the amount needed to achieve the implementation goal for aqueous methylmercury in each Delta subarea.				X
10(a)	Within each source category, cap MeHg concentrations and loads from individual MeHg sources with MeHg concentrations above the proposed implementation goal and relatively small loads discharged to impaired waterways; reduce MeHg concentrations and loads from sources with MeHg concentrations above the proposed implementation goal and relatively high methylmercury loads discharged to impaired waterways.[b]		X		
10(b)	Reduce the MeHg concentrations and loads of all individual sources with discharge MeHg concentrations above the implementation goal that discharge to impaired waterways.[b]			X	X
11(a)	Responsible parties within each source category responsible for the largest volumes of discharge within each category provide funding for the studies.[c]		X	X	
11(b)	All responsible parties within each MeHg source category that occurs in the Delta and within 30 miles of the Delta provide funding for the studies.				X

(a) Alternative 1 is the "No Action" alternative.

(b) Options 11(a) and 11(b) require that: (i) individual sources with discharge MeHg concentrations above the proposed implementation goal that discharge to unimpaired waterway would have their discharge methylmercury concentration and load capped; and (ii) individual sources with discharge MeHg concentrations below the proposed implementation goal that discharge to either impaired or unimpaired waterways would have just their MeHg concentration capped. Refer to the scenarios described in Table 4.2.

(c) For example, MS4s serving smaller municipalities (<100,000 people) and small WWTPs (<1 mgd) would not be required to contribute funds to the studies. These smaller dischargers would be required to allow access for sampling by those implementing the studies. In addition, they may be required to implement feasible control technologies and management practices once developed. Similar criteria would be developed for agricultural and wetland sources once the responsible parties have been identified during Phase 1.

- Option 3(c): Proceed with the development of allocations for the various methylmercury sources, but require further methylmercury characterization and control studies to be completed. Incorporate a methylmercury study period as "Phase 1" of the implementation program and implement methylmercury control actions during Phase 2 based on the results from ongoing CalFed studies and other studies required under Phase 1. Allocations adopted by this amendment would guide the studies. To the extent the efforts to develop methylmercury controls are effective, and/or further scientific information has been collected, subsequent TMDL revisions and Basin Plan amendments (proposed for 2014) allocate responsibility and control actions to individual point and nonpoint sources. A conditional prohibition of discharge would take effect after 31 December 2014.
- Option 5(a): Require that the cumulative inputs of new or expanded projects completed after 2014 result in no net increase in methylmercury concentrations in Delta waters above the proposed implementation goal of 0.06 ng/l. New sources with discharge methylmercury concentrations less than the implementation goal (or agricultural and wetland return water methylmercury concentrations equal to or less than source water methylmercury concentrations) may be able to contribute methylmercury loading to the Delta. However, new sources with discharge methylmercury concentrations greater than the implementation goal would need to mitigate that portion of their loading that increases their discharge concentrations above the implementation goal. Parties responsible for new wetland and agricultural projects with return water methylmercury concentrations greater than their source water methylmercury concentrations would need to mitigate that portion of the methylmercury loading that causes the exceedance. New sources that begin discharge between the amendment adoption date and 2014 would be considered in compliance with the Delta mercury control program if their responsible parties participate in the source characterization and control studies described under Consideration #2 and submit a methylmercury control plan to the Central Valley Water Board at the completion of the studies. Depending on the magnitude of new sources that begin before 2014, the allocations adopted for this amendment may need to be adjusted to accommodate any resulting increase in ambient methylmercury concentrations.
- Option 6(a): Limit total mercury point sources to annual loads observed when the adoption of a mercury offset program is considered by the Central Valley Water Board (2009 or 2014; see Consideration #4). Require no net increase in total mercury loading to the Delta from new or expanded projects completed after that date. If a new project causes increased loading to the Delta, the increased load must be mitigated through on-site reductions or an offset program. Depending on the magnitude of new sources that begin before the adoption of an offset program, the total mercury limits adopted by this amendment may need to be adjusted to accommodate any resulting increase in total mercury loading.
- Option 7(b): Address within-Delta sources of methyl and total mercury, total mercury sources in the tributary watersheds downstream of major dams, and methylmercury sources within 30 miles of the Delta within the Central Valley.

The following sections described the options that are unique to each of the alternatives.

Alternative 1: No Action.

Although the No Action alternative requires public outreach and education regarding consumption of contaminated fish, it does not require active methyl or total mercury control actions. The No Action

alternative relies on continued natural erosion and transport of sediments containing mercury out of the Delta and its tributaries and passive dilution of streambed sediments by cleaner, incoming sediment to decrease concentrations of mercury in surficial sediment thereby decreasing methylmercury production in the Delta. Methyl and total mercury would continue to be discharged from point and nonpoint sources in the Delta. Mercury-contaminated sediments would continue to erode from the inactive mercury and gold mines in the tributary watersheds directly into tributary waters and transported to the Delta and San Francisco Bay.

Because this alternative allows continued discharge from point and nonpoint sources in the Delta and its tributary watersheds, it is highly unlikely that the fish tissue objectives would be reached through passive sedimentation alone within the next several centuries. The same would be true for complying with the San Francisco Bay Water Board's allocation for total mercury from the Central Valley. In addition, because anticipated population growth and habitat restoration projects in the Delta and its tributary watersheds may lead to increases in methylmercury levels in Delta waters, fish tissue methylmercury levels are likely to increase in the Delta before any reductions are seen due to passive dilution.

Alternative 2: Methylmercury Studies from Large Load-based Sources, Methylmercury Reductions from Large Load-based Individual Sources that Discharge Concentrations Greater than the Proposed Aqueous Goal to Impaired Waterways & Total Mercury Reductions from Major Tributary Watersheds

In addition to the "Common Options" listed previously, Alternative 2 includes the following:

- Option 4(b): Develop an offset program for both methyl and total mercury for Central Valley Water Board consideration by 2014, after completion of proposed methylmercury characterization and control studies.
- Option 8(a): Focus total mercury load reduction efforts on nonpoint sources in the tributary watersheds that export the most mercury-contaminated sediment and cap all other point and nonpoint sources in the Delta and its source region to reduce overall total mercury loading to the Delta by 110 kg/yr.
- Option 9(a): Require that only load-based methylmercury sources (e.g., wastewater treatment plants, urban runoff, and agricultural return water) be reduced by the amount needed to achieve the implementation goal for aqueous methylmercury in each Delta subarea. Do not address nonload-based factors such as flood conveyance and other water management activities. This option would rely upon methylmercury allocations being implemented through utilization of Central Valley Water Board authority to issue NPDES permits, WDRs, and other means of controlling surface water discharges.
- Option 10(a): Within each source category, cap MeHg concentrations and loads from individual methylmercury sources with methylmercury concentrations above the proposed implementation goal and relatively small loads discharged to impaired waterways; reduce methylmercury concentrations and loads from sources with methylmercury concentrations above the proposed implementation goal and relatively high methylmercury loads discharged to impaired waterways.[17]

[17] Options 10(a) and 10(b) both require that: (i) individual sources with discharge MeHg concentrations above the proposed implementation goal that discharge to unimpaired waterway would have their discharge methylmercury concentration and load

- Option 11(a): Responsible parties within each source category responsible for the largest volumes of discharge within each category take the lead and conduct the studies. For example, MS4s serving smaller municipalities (<100,000 people) and small WWTPs (<1 mgd) would not be required to conduct the studies. These smaller dischargers would be required to allow access for sampling by those implementing the studies. Both large and small dischargers may be required to implement feasible control technologies and management practices once developed. Similar criteria (e.g., acreage) would be developed for individual agricultural and wetland sources once the responsible parties have been identified during the beginning of Phase 1.

Table 4.4 at the end of this section illustrates the suite of control strategies derived from the options addressed by Alternative 2 for the apportioning of responsibility for individual total and methylmercury sources.

Alternative 3: Methylmercury Studies from Large Load- and Nonload Based Sources, Methylmercury Reductions from All Load-Based Sources that Discharge Concentrations Greater than the Proposed Aqueous Goal to Impaired Waterways and Total Mercury Reductions from Major Tributary Watersheds

In addition to the "Common Options" listed previously, Alternative 3 includes the following options included in Alternative 2:

- Option 8(a): Focus total mercury load reduction efforts on nonpoint sources in the tributary watersheds that export the most mercury-contaminated sediment (American River, Cache Creek, Feather River and Putah Creek) and cap all other point and nonpoint sources in the Delta and its source region to reduce overall total mercury loading to the Delta by 110 kg/yr.
- Option 11(a): Responsible parties within each source category responsible for the largest volumes of discharge within each category take the lead and conduct the studies. For example, MS4s serving smaller municipalities (<100,000 people) and small WWTPs (<1 mgd) would not be required to conduct the studies. These smaller dischargers would be required to allow access for sampling by those implementing the studies. Both large and small dischargers may be required to implement feasible control technologies and management practices once developed. Similar criteria (e.g., acreage) would be developed for individual agricultural and wetland sources once the responsible parties have been identified during the beginning of Phase 1.

Alternative 3 is different from Alternative 2 in that it includes the following three options:

- Option 4(c): Develop a total mercury offset program based on currently available information for Central Valley Water Board consideration by 2009. Develop a methylmercury offset program later (e.g., by 2014) so that it can be guided by the results of the proposed methylmercury characterization and control studies.
- Option 9(b): Reduce the load-based methylmercury sources by the amount needed to achieve the implementation goal for aqueous methylmercury in each Delta subarea, characterize and cap existing nonload-based factors such as flood conveyance and other water management activities,

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capped; and (ii) individual sources with discharge MeHg concentrations below the proposed implementation goal that discharge to either impaired or unimpaired waterways would have just their MeHg concentration capped. Refer to the four scenarios described in Table 4.2.

and require mitigation for impacts caused by future changes to nonload-based factors. (Alternative 2 does not address nonload-based methylmercury source categories.) This option would rely upon development of inter-agency agreements to ensure that existing impacts of these nonload related factors are properly characterized. In addition, this option would rely upon utilization of 401 certification authority over future watershed projects, coordination with SWRCB authority over water rights, and other inter-agency agreements and measures to ensure that future impacts of these nonload related factors are either reduced or mitigated.

- Option 10(b): Reduce the methylmercury concentrations and loads of <u>all</u> individual sources with discharge methylmercury concentrations above the implementation goal that discharge to impaired waterways (not just the largest dischargers).[17]

Table 4.4 illustrates the suite of control strategies derived from the options addressed by Alternative 3 for the apportioning of responsibility for individual total and methylmercury sources.

Alternative 4: Methylmercury Studies from All Load- and Nonload Based Sources, Methylmercury Reductions from All Load-Based Sources that Discharge Concentrations Greater than the Proposed Aqueous Goal to Impaired Waterways and Nonload-based Sources that Discharge to Impaired Waterways, and Total Mercury Reductions from All Delta and Tributary Sources

In addition to the "Common Options" listed previously, Alternative 4 includes the following options included in Alternative 3:

- Option 4(c): Develop a total mercury offset program based on currently available information for Central Valley Water Board consideration by 2009. Develop a methylmercury offset program later (e.g., by 2014) so that it can be guided by the results of the proposed methylmercury characterization and control studies.
- Option 10(b): Reduce the methylmercury concentrations and loads of all individual sources with discharge methylmercury concentrations above the implementation goal that discharge to impaired waterways.[17]

Alternative 4 is different from Alternative 3 in that it includes the following three options:

- Option 8(b): Reduce all total mercury source categories equally by the amount needed to reduce overall total mercury loading to the Delta by 110 kg/yr (not just the nonpoint sources in the tributary watersheds that export the most mercury-contaminated sediment).
- Option 9(c): Reduce both load- and nonload-based methylmercury source categories by the amount needed to achieve the implementation goal for aqueous methylmercury in each Delta subarea (not just the load-based sources). This option would rely upon utilization of 401-certification authority over future watershed projects, coordination with SWRCB authority over water rights, and other inter-agency agreements and measures to ensure that existing and future impacts of nonload related factors such as flood conveyance and other water management activities are properly characterized and either reduced or mitigated.
- Option 11(b): <u>All</u> responsible parties within each source category that occurs in the Delta or within 30 miles of the Delta conduct studies (not just the largest dischargers).

Table 4.4 illustrates the suite of control strategies derived from the options addressed by Alternative 4 for the apportioning of responsibility for individual total and methylmercury sources.

4.2.3 Evaluation of Implementation Alternatives

All four alternatives require public outreach and education regarding consumption of contaminated fish. Alternative 1 does not require any methyl or total mercury control actions. Alternatives 2 through 4 require control actions that address existing within-Delta sources of methyl and total mercury, total mercury sources in the tributary watersheds downstream of major dams, and methylmercury sources within 30 miles of the Delta within the Central Valley. In addition, Alternatives 2 through 4 include the requirement that new sources that begin discharging after 2014 with discharge methylmercury concentrations greater than the implementation goal would need to mitigate that portion of their loading that increases their discharge concentrations above the implementation goal, and that new sources of total mercury loading after 2008 or 2014 (depending on the source and which option is selected for total mercury offset program development) mitigate their entire loads. A methyl and total mercury offset program would be part of all three alternatives; only the timing of the total mercury offset program is different. Alternatives 2 through 4 have several differences that center mainly on the level of effort required from the variety of source categories and individual dischargers of methyl and total mercury. The following sections evaluate the possibility of each alternative enabling the attainment of the proposed water quality objectives for methylmercury in Delta fish, and the potential cost and feasibility of each alternative.

Attainment of Water Quality Objectives

Central Valley Water Board staff does not expect that the proposed water quality objectives would be attained under Alternative 1 (No Action). This alternative would allow existing point and nonpoint methyl and total mercury sources to continue discharge at their current rates and for new sources to increase the methylmercury concentration and total mercury loading in Delta waters. As noted earlier, natural erosion and sediment deposition will eventually reduce sediment mercury concentrations, but the continuing inputs make significant improvements unlikely for centuries to come if at all.

Alternatives 2 through 4 should prevent fish mercury levels from increasing by requiring no net increase in methylmercury concentrations and total mercury loading in the Delta. In addition, all three alternatives would implement actions focused on reducing methylmercury concentrations in Delta waters to 0.06 ng/l, which should result in fish tissue concentrations being reduced to levels protective of humans and wildlife consuming local fish. Water quality objectives are expected to be achieved under Alternatives 2 through 4. Staff estimates that fish tissue objectives will be achieved approximately five to ten years (two to three fish life cycles) after the aqueous methylmercury goal is met. More rapid decreases in fish tissue concentrations are expected to occur soon after the major control actions are completed, with more gradual declines in fish tissue concentrations occurring as sediment concentrations continue to decline through natural erosion.

Alternatives 2 and 3 focus total mercury load reduction efforts on nonpoint sources in the tributary watersheds that export the most mercury-contaminated sediment and cap all other point and nonpoint sources in the Delta and its tributary watersheds downstream of major dams. Alternative 4 would require all point and nonpoint sources in the Delta and its source region to reduce total mercury loading, which is a more equitable manner to apportion control responsibility. In addition, reduction efforts for point source categories are the most likely to succeed within a timely period. However, as noted earlier, almost all the total mercury loading to the Delta comes from tributary inputs, almost entirely from nonpoint sources. In addition, the San Francisco Bay mercury TMDL expects the Central Valley to meet its total

Table 4.4(a): Control Strategies for Existing Sources of Methyl and Total Mercury – Source-Specific Alternatives.[a] ["Alternative 1" for all source categories is "no action".]

Source Category	Alternative 2	Alternative 3	Alternative 4
Agricultural sources of MeHg in the Delta & within 30 miles [b,c]	• Cap methylmercury (MeHg) loads and concentrations at existing levels in runoff from agricultural areas with relatively low loading rates that discharge to impaired waterways. • Reduce loads and concentrations in discharges from areas with relatively high loading rates that discharge to impaired waterways by amount needed to achieve WQO. • Cap MeHg loads and concentrations from all agricultural areas that discharge to unimpaired waterways. • Responsible parties for large tracts of agricultural land required to conduct MeHg characterization and control development studies.	• Reduce MeHg loads and concentrations in runoff from all agricultural areas that discharge to impaired waterways by amount needed to achieve WQO. • Cap MeHg loads and concentrations from all agricultural areas that discharge to unimpaired waterways. • Responsible parties for large tracts of agricultural land required to conduct MeHg characterization and control development studies.	*Same as Alternative 3, except:* • Responsible parties for all agricultural areas required to conduct MeHg characterization and control development studies.
Atmospheric deposition [d]	• No action.	• Cap total mercury (TotHg) loads produced by local and statewide air emission sources. • Conduct TotHg characterization and control studies. • Implement feasible load reductions if studies indicate atmospheric loading from local or statewide sources is substantial.	• Reduce TotHg loads produced by all local air emission sources in the Delta and tributary watersheds downstream of major dams by ~30%.[e] • Conduct TotHg characterization and control studies. • Implement feasible load reductions or otherwise mitigate TotHg loading to achieve TotHg limit.
Dredging within the Delta [f]	• No action.	• Projects characterize TotHg and MeHg loads removed from Delta waterways by dredge activities, and contributed by return flow from dredge spoil settling ponds. • Projects employ management practices to prevent increases in MeHg concentrations and TotHg loading in the Delta.	• Projects characterize TotHg and MeHg loads removed from Delta waterways by dredge activities, and contributed by return flow from dredge spoil settling ponds. • Projects employ management practices to prevent increases in MeHg concentrations and TotHg loading in the Delta. • All projects reduce TotHg loading in return flows by ~30%.[e] • Projects with return flow MeHg concentrations greater than the proposed implementation goal reduce MeHg loading and concentration of return flows by amount needed to achieve WQO.

Table 4.4(a): Control Strategies for Existing Sources of Methyl and Total Mercury – Source-Specific Alternatives.[a] ["Alternative 1" for all source categories is "no action".]

Source Category	Alternative 2	Alternative 3	Alternative 4
Yolo Bypass MeHg loading caused by flood conveyance flows [f]	• No action.	• Cap MeHg loads generated by flood flows in Yolo Bypass. • Conduct MeHg characterization and control studies. Implement feasible controls.	• Reduce MeHg loads generated by flood flows in Yolo Bypass by amount needed to achieve WQO. • Conduct MeHg characterization and control studies. Implement feasible controls or otherwise mitigate MeHg loading above MeHg allocation.
NPDES facilities that discharge > 1 mgd within the Delta & tributary watersheds downstream of major dams [g,h]	• Cap TotHg loads from all facilities that discharge > 1 mgd to the Delta or its tributaries downstream of major dams based on their 2012 annual loads. • Cap or reduce MeHg concentrations and/or loads from all facilities that discharge to the Delta or within 30 miles of the Delta: - Cap loads from facilities with effluent MeHg concentrations above the proposed implementation goal and relatively small loads discharged to impaired waterways. - Reduce by amount needed to achieve WQOs the MeHg concentrations and loads from facilities with effluent MeHg concentrations above the proposed implementation goal and relatively high loads discharged to impaired waterways. - Cap MeHg concentrations and loads from all facilities that discharge to the Delta or within 30 miles of the Delta with discharge MeHg concentrations above the proposed implementation goal that discharge to unimpaired waterways. - Cap MeHg concentrations from facilities with effluent MeHg concentrations below the proposed implementation goal that that discharge to either impaired or unimpaired waterways. • Facilities that discharge >1 mgd to the Delta or within 30 miles of the Delta conduct MeHg characterization and control studies. • MeHg allocations for existing facilities based on current (2005) discharge volumes & loads.	• Cap TotHg loads from all facilities that discharge > 1 mgd to the Delta or its tributaries downstream of major dams based on their 2008 annual loads. • Cap or reduce MeHg concentrations and/or loads from all facilities that discharge to the Delta or within 30 miles of the Delta: - Reduce by amount needed to achieve WQOs the MeHg concentrations and loads from all facilities that discharge to the Delta or within 30 miles of the Delta with effluent MeHg concentrations above the proposed implementation goal that discharge to impaired waterways. - Cap MeHg concentrations and loads with discharge MeHg concentrations above the proposed implementation goal that discharge to unimpaired waterway. - Cap MeHg concentrations from facilities with effluent MeHg concentrations below the proposed implementation goal that that discharge to either impaired or unimpaired waterways. • Facilities that discharge >1 mgd to the Delta or within 30 miles of the Delta conduct MeHg characterization and control studies. • MeHg allocations for existing facilities based on current (2005) discharge volumes & loads.	*Same as Alternative 3, except:* • Reduce TotHg loads from all facilities that discharge > 1 mgd to the Delta or its tributaries downstream of major dams by ~30%.[e] • All facilities conduct MeHg characterization and control studies.

Table 4.4(a): Control Strategies for Existing Sources of Methyl and Total Mercury – Source-Specific Alternatives.[a] ["Alternative 1" for all source categories is "no action".]

Source Category	Alternative 2	Alternative 3	Alternative 4
NPDES MS4s within the Delta & tributary watersheds downstream of major dams [c,g]	• Cap TotHg loads from all MS4s that discharge to the Delta or its tributaries downstream of major dams based on annual loads observed through 2011. • Cap or reduce MeHg concentrations and loads in urban runoff from all MS4s that discharge to the Delta or within 30 miles of the Delta: - Cap MeHg loads and concentrations at existing levels from Phase II MS4s that discharge to impaired waterways. - Reduce loads and concentrations in discharges from Phase I MS4s that discharge to impaired waterways by amount needed to achieve WQO. - Cap MeHg loads and concentrations from all MS4s that discharge to unimpaired waterways. • Phase I MS4s in the Delta or within 30 miles of the Delta required to conduct MeHg characterization and control development studies.	• Cap TotHg loads from all MS4s that discharge to the Delta or its tributaries downstream of major dams based on annual loads observed through 2011. • Reduce MeHg loads and concentrations in urban runoff from all MS4s that discharge to impaired waterways in the Delta or within 30 miles of the Delta by amount needed to achieve the Delta WQOs. • Cap MeHg loads and concentrations from all MS4s that discharge to unimpaired waterways in the Delta or within 30 miles of the Delta. • Phase I MS4s in the Delta or within 30 miles of the Delta required to conduct MeHg characterization and control development studies.	*Same as Alternative 3, except:* • Reduce TotHg loads from all MS4s that discharge to the Delta or its tributaries downstream of major dams by ~30%.[e] • All MS4s in the Delta or within 30 miles of the Delta required to conduct MeHg characterization and control development studies.
Open channels: water management practices [f]	• No action.	• Cap MeHg loads from open channel sediments in the Delta and within 30 miles of the Delta resulting from (i) current water deliveries to, diversions from, and storage within the Delta, and (ii) from current operations to maintain salinity standards in the Delta. • Mitigate any increase in MeHg loading resulting from future changes to water management practices (e.g., changes to Friant Dam flows, actions taken by the South Delta Improvement Program, and changes to salinity standards). • State and federal agencies characterize effects on Delta MeHg levels from future changes to water management practices and conduct MeHg control studies.	• Reduce MeHg loads from open channel sediments in the Delta and within 30 miles of the Delta resulting from current water management practices in the Delta by amount needed to achieve WQO. Mitigate any increase in MeHg loading resulting from future changes to water management practices. • State and federal agencies and private entities characterize effects on Delta MeHg levels from ongoing operations and future changes to water management practices and conduct MeHg control studies.

Table 4.4(a): Control Strategies for Existing Sources of Methyl and Total Mercury – Source-Specific Alternatives.[(a)] ["Alternative 1" for all source categories is "no action".]

Source Category	Alternative 2	Alternative 3	Alternative 4
Wetlands currently within the Delta, 30 miles upstream of the Delta [(c)]	• Cap MeHg loads and concentrations at existing levels in runoff from wetland and riparian areas with relatively low loading rates that discharge to impaired waterways. • Reduce MeHg loads and concentrations in discharges from areas with relatively high loading rates that discharge to impaired waterways by amount needed to achieve WQO. • Cap MeHg loads and concentrations from all areas that discharge to unimpaired waterways. • Responsible parties for large tracts of wetland and riparian lands required to conduct MeHg characterization and control development studies.	• Reduce MeHg loads and concentrations in runoff from all wetland and riparian areas that discharge to impaired waterways by amount needed to achieve WQO. • Cap MeHg loads and concentrations from all areas that discharge to unimpaired waterways. • Responsible parties for large tracts of wetland and riparian lands required to conduct MeHg characterization and control development studies.	*Same as Alternative 3, except:* • Responsible parties for all wetland and riparian areas required to conduct MeHg characterization and control development studies.

(a) Reductions recommended to meet the Delta WQO would act as minimum requirements for tributary sources. Additional reductions may be necessary in the future to achieve tributary-specific WQOs.

(b) It is assumed that agricultural areas do not act as a source of total mercury loading to the Delta. If new information from future studies indicates otherwise (e.g., agricultural practices cause erosion that results in sediment and total mercury discharges), staff will consider control actions for total mercury.

(c) All methylmercury samples collected to date from agricultural and urban runoff and wetland outflows have methylmercury concentrations greater than the proposed implementation goal. If future studies identify agricultural, urban or wetland areas with discharge methylmercury concentrations less than the proposed implementation goal, then the allocation strategy alternatives described for the NPDES Facility source category would be employed.

(d) Based on available information, it is assumed that atmospheric deposition does not act as a significant source of methylmercury loading to the Delta.

(e) Table 7.1 in the TMDL Report provides the average annual total mercury loads for within-Delta point and nonpoint sources and tributary inputs for WY2000-2003, a relatively dry period. As shown in Table 7.6b, adequate data were available to estimate long-term average annual loading for Sacramento River and Yolo Bypass inputs for WY1984-2003, a 20-year period that includes a mix of wet and dry years that is statistically similar to what has occurred in the Sacramento basin over the last 100 years. The sum of WY1984-2003 annual loads from the Sacramento River and Prospect Slough (344 kg/yr) and WY200-2003 loads from other tributary and within-Delta inputs (38 kg/yr) is 382 kg/yr. A reduction of 110 kg/yr to comply with the San Francisco Bay Water Board's allocation for the Central Valley equates to a 29% reduction in total mercury loading from tributary and within-Delta sources.

(f) Nonload-based factors affecting aqueous methylmercury levels in the Delta could include: (i) Increased methylation rates in Yolo Bypass habitats resulting from flood conveyance flows; (ii) The potential effect of basin geometry on methylation in the Cache Creek Settling Basin; (iii) Potentially increased methylation rates in the Delta resulting from exposure of sediments with high total mercury concentrations by dredging activities; and (iv) Potentially increased methylation rates in the Delta resulting from future changes in water delivery to, or diversions from, the Delta, or future changes to salinity standards or flow management practices used to maintain current salinity standards. Although they are contributing factors, these are not loads of a substance for which methylmercury allocations can be made.

(g) Methylmercury allocations apply to methylmercury sources in the Delta and within 30 miles upstream of the Delta. Total mercury limits apply to total mercury sources in the Delta and its tributary watersheds downstream of major dams.

(h) Facilities that discharge greater than 1 mgd account for about 97% of the volume discharged from permitted facilities in the Delta and its tributary watersheds downstream of major dams. Facilities with discharge less than 1 mgd would not be assigned total mercury limits during Phase I of the proposed control program.

Table 4.4(b): Control Alternatives for Existing Sources of Methyl and Total Mercury – Watershed Alternatives. ["Alternative 1" is the "no action" alternative.]

Source Category	Alternative 2	Alternative 3	Alternative 4
Cache Creek watershed & Cache Creek Settling Basin	• Improve efficiency of Cache Creek Settling Basin to 72% to trap an additional 55 kg/yr of TotHg leaving the basin. [(a, b, c)] • Reduce MeHg loads and concentrations discharged from the Cache Creek Settling Basin by amount needed to achieve WQO in Yolo Bypass.[(d)]	*Same as Alternative 2.*	*Same as Alternative 2, except:* • Improve efficiency of Cache Creek Settling Basin to about 90%.[(d)]
Other tributary watersheds	• Reduce by 38 kg/yr the sum of TotHg loads from the American River, Putah Creek & Feather River to the Delta. • Cap TotHg sources in other tributaries. • Reduce MeHg loads and concentrations from the Sacramento River, Yolo Bypass, San Joaquin River & Mokelumne River (tributaries that contribute both high MeHg concentrations & high MeHg loads to the Delta) by the amount needed to achieve the WQO in each Delta subarea. • Cap MeHg loads and concentrations from Calaveras River, French Camp Slough, Bear/Mosher Creeks, Ulatis Creek, Morrison Creek, Marsh Creek & other small drainages (tributaries that do not contribute both high MeHg concentrations & loads).	*Same as Alternative 2.*	• Reduce all tributary TotHg loads by ~28%.[(e)] • Reduce all tributary MeHg loads and concentrations by the amount needed to achieve the WQO in each Delta subarea.

(a) The Cache Creek Settling Basin traps about 50% of sediment and total mercury that enters it from the Cache Creek watershed. On average, the basin receives ~250 kg/yr from the Cache Creek watershed and discharges about 125 kg/yr to the Yolo Bypass. The sediment/mercury trapping efficiency of the Cache Creek Settling Basin is expected to decrease as the basin fills and may reach zero in about 40 years unless a maintenance program is instituted to periodically remove material. A non-operational Settling Basin would result in a long-term increase of about 125 kg/yr in Delta loads. At a minimum, a sediment maintenance program must be developed to ensure Settling Basin continues to trap at least 50% of sediment and TotHg that enters the basin.

(b) Initial modeling results indicate that Settling Basin operation and design could be modified to remove up to an additional 55 kg/yr (CDM, 2004, Table 4-3, Alternative 5 - Excavate and Raise Weir Early), improving the current trapping efficiency of the Settling Basin from 50% to 72%.

(c) Implementation actions resulting from the Cache Creek mercury control program would reduce average annual mercury loads entering the Settling Basin by about 60 kg/yr, from 250 to 190 kg/yr. Because of the current 50% trapping efficiency of the Settling Basin, discharges leaving the Settling Basin would be reduced by 30 kg/yr, from 125 kg/yr to 95 kg/yr. If the Settling Basin trapping efficiency were improved from 50% to 72%, and Settling Basin inputs were reduced from 250 kg/yr to 190 kg/yr, then Settling Basin mercury discharges would decrease from the current 125 kg/yr to a future 53 kg/yr, for a total reduction of 72 kg/yr from the Settling Basin.

(d) Cache Creek Settling Basin discharges have an average methylmercury concentration of 0.558 ng/l. A 90% reduction would be required to achieve the proposed implementation goal for the Delta in the area of the Yolo Bypass dominated by Settling Basin discharges. Improving the efficiency of Settling Basin to trap 80 to 95% of TotHg loads currently leaving the basin may be needed to achieve necessary reductions in aqueous and fish MeHg in the Yolo Bypass.

(e) Table 7.1 in the TMDL Report provides the average annual total mercury loads for within-Delta point and nonpoint sources and tributary inputs for WY1984-2003, a 20-year period that includes a mix of wet and dry years that is statistically similar to what has occurred in the Sacramento basin over the last 100 years. A reduction of 110 kg/yr to comply with the San Francisco Bay Water Board's allocation for the Central Valley equates to a 28% reduction in total mercury loading from tributary inputs.

mercury load allocation in twenty years and has an interim milestone of half the allocation in ten years. Actions proposed by the Cache Creek mercury control program would require mines to be remediated within ten years and other projects to begin implementation within the same time schedule. In addition, there are ongoing mercury studies in the Yuba and Bear River watersheds within the Feather River watershed currently evaluating sources of mercury. Therefore, focusing reduction efforts on upstream nonpoint sources would make the implementation program more likely to succeed in measurably reducing total mercury loads.

Alternative 2 focuses methylmercury reduction efforts on load-based methylmercury sources. Alternative 3 does the same, but also requires responsible parties for nonload-based sources (e.g., flood conveyance and other water management activities) to characterize their effects on methylation in the Delta, evaluate control options, and mitigate impacts caused by future changes. Alternative 4 requires reductions from both load- and nonload-based sources. Alternative 4 is more equitable than Alternatives 2 and 3 because it accounts for the real impact of nonload related factors on existing conditions in the Delta, rather than placing the burden entirely on load-based sources. There is also a degree of increased flexibility and likelihood of success associated with having more causes and potential solutions to the problem being considered. However, as described in the previous section, the Central Valley Water Board has limited jurisdiction over several of the nonload related factors, and there is some uncertainty about whether the impact of these factors can be addressed in a timely manner.

Alternative 2 would require methylmercury reductions only from large point and nonpoint sources that discharge concentrations greater than the proposed aqueous goal to impaired waterways. Alternatives 3 and 4 would require methylmercury reductions from all point and nonpoint sources that discharge concentrations greater than the proposed aqueous goal to impaired waterways. Alternatives 3 and 4 have a more equitable approach, given the nature of the MS4 and nonpoint source discharges (each is typically comprised of a myriad of individual discharges) and the lack of existing control methods (it is not yet known which methylmercury sources will be the easiest to control).

Estimated Cost

[To be included in the next draft report.]

Feasibility

This section examines the technical feasibility of the four proposed alternatives. Actions are considered technically feasible if current technology and remediation practices are available for the various projects.

Implementation Alternative 1 is technically feasible because (a) proposed public outreach and education activities are based on existing programs, and (b) no remediation activities are proposed. Implementation Alternatives 2 through 4 address both total and methylmercury sources.

The total mercury control actions proposed by Alternatives 2 through 4 are considered technically feasible. In general, the proposed control actions are feasible; however, as noted above, costs increase with increasing remediation efforts. For example, the SRCSD's Sacramento River WWTP reduced its influent mercury loads through pollution prevention, including pretreatment and public education. However, adequate on-site load controls may not be technically or economically feasible for some sources that expect to grow substantially in the future. It is not a goal of the proposed mercury

implementation program to inhibit otherwise beneficial projects. Therefore, to achieve the goal of no net increase in total mercury loading to the Delta, the Central Valley Water Board may allow responsible parties to participate in a mercury offset program *in lieu* of making on-site load controls. Offset projects can reduce mercury loading from another part of the Delta or its tributary watersheds where load reductions are not likely to occur in a reasonable amount of time. Sources of total mercury in the Delta's tributary watersheds that are likely candidates for offset projects include the Cache Creek Settling Basin, historic gold and mercury mine sites, legacy mercury in the stream channel sediments, and geothermal springs.

In general, total mercury reductions through mine remediation projects are considered feasible because mines have been successfully remediated in other parts of the Central Valley. Metal mines such as Walker Mine, Penn Mine, Iron Mountain Mine, and numerous smaller mines in the Lake Shasta watershed have significantly reduced their metal loading into surface waters by greater than 95% (personal communication from Central Valley Water Board Redding staff). Similarly, inactive mines in the Cache Creek watershed are expected to be able to reduce anthropogenic sources of mercury loading by 95%. In addition, management practices for erosion control in mercury-enriched areas are feasible, as management practices have been developed for erosion controls. The more infeasible activities may include sediment removal in the channels contaminated with legacy mercury in areas where vehicle and equipment access is difficult or where there are sensitive habitats. Active or passive remediation of geothermal springs may be technically feasible, but treatment may not be practical if the springs are too remote.

Implementation actions to address methylmercury sources are also technically feasible. Alternatives 2 through 4 incorporate methylmercury characterization and control studies in Phase I of the proposed implementation plan. Methods for accurate methylmercury sample collection and analysis are well developed. The need for studies is prompted by data showing that similar types of methylmercury sources produce varying concentrations of methylmercury. These data suggest that that detailed evaluations of these sources could reveal management measures to minimize methylmercury loads. For example, preliminary monitoring results from municipal WWTPs indicate that 28 of 65 facilities have effluent concentrations less than 0.06 ng/l, and that some facilities have higher effluent methyl to total mercury ratios than others (Appendix G in the TMDL Report). A similar pattern is seen in preliminary data from studies of different types of wetlands in the Sacramento and San Joaquin River Basins: high aqueous and fish methylmercury concentrations in some, and low methylmercury concentrations in others (C. Foe, personal communication; D. Slotton, personal communication[18]). On a single Delta island experimental wetland, two different wetland designs produced significantly different fluxes of methylmercury leaving the wetland areas (Sassone *et al*., 2004). These patterns indicate that it may be feasible to control methylmercury from some sources through design and management control options. However, if on-site methylmercury controls developed by these studies are not adequate to reduce ambient methylmercury to levels needed to achieve the proposed water quality objectives throughout the Delta, then corresponding offsets for total mercury or methylmercury may need to be considered in Phase II of the proposed implementation program.

[18] Year one data from a three-year study by D. Slotton, S. Ayers and D. Weyland on mercury in biosentinel fish in the Delta, funded by the California Bay-Delta Program is available at: http://www.sfei.org/cmr/fishmercury/June_13_June14_2006.htm

4.2.4 Recommended Implementation Alternative

Central Valley Water Board staff recommends Implementation Alternative 3 for adoption into the Basin Plan. This alternative includes the following components:

- Incorporate **methylmercury allocations** for methylmercury point and nonpoint sources in the Delta and within 30 miles upstream of the Delta. Methylmercury allocations are used as guidance for methylmercury characterization and control studies.
- Incorporate a methylmercury characterization and control study period as **Phase 1** (2007-2014) of the implementation program. The largest dischargers within each source category would be responsible for conducting methylmercury characterization and control studies and developing management practices or treatment options to reduce methylmercury discharges.
- Characterize and limit existing methylmercury inputs that result from flood conveyance, maintenance of salinity standards and other water management practices; require mitigation for impacts caused by future changes to flood conveyance and other water management practices; and recommend actions for the agencies responsible for water management.
- New methylmercury sources that begin discharge between the amendment adoption date and 2014 would be considered in compliance with the Delta mercury control program if their responsible parties participate in the source characterization and control studies and submit a methylmercury control plan to the Central Valley Water Board at the completion of the studies. Depending on the magnitude of new sources that begin discharging before 2014, methylmercury allocations may need to be adjusted to accommodate any resulting increase in ambient methylmercury concentrations.
- By 2014, staff reviews study results, methylmercury control options, and methylmercury allocations, revises the TMDL, and recommends changes to the methylmercury control program. The Central Valley Water Board considers a Basin Plan amendment for an updated methylmercury control program.
- For **Phase 2** of the methylmercury control program (after 2014), responsible parties implement approved methylmercury control actions based on the results from the Phase 1 study period and ongoing CalFed studies. Full compliance with the methylmercury allocations is required by 2029, or sooner if required by Regional Board adopted implementation schedules.
- Include a conditional prohibition of methylmercury discharge after 2014.
- Require that methylmercury concentrations in the Delta's ambient waters not increase as a result of new or expanded projects initiated after 2014. Return waters from new agricultural areas or wetland or other habitat restoration projects would require mitigation for that portion of their loading that increases their methylmercury concentration above their source water methylmercury concentration. Other new sources discharging methylmercury concentrations less than the implementation goal (0.06 ng/l methylmercury) would be allowed to contribute methylmercury loading to the Delta. However, new sources with discharge methylmercury concentrations greater than the implementation goal would need to mitigate that portion of their load that increases their discharge concentrations above the implementation goal.
- Incorporate **total mercury limits** for point sources in the Delta and its tributary watersheds downstream of major dams, and reduction actions for tributary watersheds that export the most mercury-contaminated sediment to the Delta to reduce overall total mercury loading to the Delta by 110 kg/yr.

- Require that total mercury loading to the Delta not increase as a result of new or expanded projects. Any increase in total mercury loading would need to be mitigated or in compliance with an offset program.
- Develop an **offset program** for total mercury based on currently available information for Central Valley Water Board consideration in 2009. Develop a methylmercury offset program by 2014, so that the program can be guided by results available from the proposed methylmercury characterization and control studies.
- Incorporate an **expanded public education and outreach program** that coordinates efforts between the State and Regional Water Boards, Office of Environmental Health Hazard Assessment, Department of Health Services, local county health departments, and dischargers.

Focusing total mercury load reduction efforts on the Sacramento basin watersheds with relatively large mercury loadings and high mercury concentrations in suspended sediment – Cache Creek, Feather River, American River and Putah Creek watersheds – is considered to the be most effective strategy for reducing total mercury loads discharged to the Delta and San Francisco. The options selected for the study and control of methylmercury balance equitability, the likelihood of success, and jurisdictional constraints.

Development and implementation of nonpoint source management practices have traditionally proved difficult in California. The Central Valley Water Board may need to consider in Phase II whether satisfactory progress is being made on characterizing nonpoint source concentrations and loads to the Delta and whether effective management practices are possible. If effective management practices are not possible, then the Central Valley Water Board may need to consider requiring additional methylmercury load reductions from point source facilities located in critical Delta subareas and source areas outside the Delta. The Central Valley Water Board may also need to reconsider the proposed requirement of no net increase in ambient methylmercury above the proposed implementation goal as a result of new projects located in these subareas after 2014, and instead require reductions or more offset to ensure that ambient methylmercury concentrations in the Delta decrease to a safe level.

4.3 Recommended Program of Implementation

This section provides a detailed description of how Alternative 3 (summarized in Section 4.2.4) could be implemented. It outlines recommended actions and timelines for those responsible for maintaining and reducing methyl and total mercury sources and actions the Central Valley Water Board can take to ensure their completion. Also included are various recommendations to the State Water Board and other agencies regarding actions that should be taken for which the Central Valley Water Board may not have direct authority. These required and recommended actions are based on Implementation Alternative 3 (see Section 4.2.4) and are reflected in the proposed Basin Plan language provided after the Executive Summary at the beginning of this report.

The problem with mercury in the Delta's aquatic ecosystems can be defined as biotic exposure to methylmercury. Therefore, decreasing biotic exposure to methylmercury is the ultimate goal of the Delta mercury TMDL and implementation program. In addition, the mercury control program for the Delta must enable compliance with the San Francisco Bay Water Board's total mercury allocation for the Central Valley (a five-year average total mercury load reduction of 110 kg/yr within 20 years) and the USEPA's CTR criterion of 50 ng/l for total mercury in the water column. To achieve these goals, staff recommends a two-phased implementation program with the following objectives:

Phase I:

- Characterize individual point and nonpoint sources of methylmercury and develop control methods.
- Establish a total mercury offset program.
- Develop plans to reduce total mercury loads entering the Delta by at least 110 kg per year.
- Establish a requirement of no net increase in total mercury loading to the Delta as a result of new or expanded projects; mitigate any increase in total mercury loading.
- Reduce methylmercury exposure to the fish eating public.

Phase II:

- Reduce existing point and nonpoint methylmercury sources using control methods identified in Phase I.
- Establish a requirement of no net increase in methylmercury concentrations above the proposed implementation goal of 0.06 ng/l in Delta waters resulting from the cumulative inputs of new or expanded projects completed after 2014.
- Establish a methylmercury offset program.

The recommended actions and timelines required to achieve these objectives are summarized in Table 4.5 and are bulleted in source-specific "action boxes" in each of the following sections. The timelines listed in the action boxes are subject to change depending on the length of the Basin Plan amendment approval process. The dates provided are based on the assumption that the Central Valley Water Board will adopt a Basin Plan amendment in late 2006 and that the State Water Board, Office of Administrative Law and USEPA grant their approval of the amendment within the six months that follow.

The Central Valley Water Board will employ an adaptive management approach to implementing Phase I of the program and developing actions for Phase II. Staff will evaluate new data and scientific information to determine the most effective control program and allocations to reduce methylmercury and total mercury sources in the watershed. In addition, the proposed timelines will be adjusted as necessary due to the Central Valley Regional Board BPA adoption and State Water Board and USEPA approval process.

It is not the intent of the Central Valley Water Board to limit urban growth (e.g., through connection bans) or inhibit habitat restoration, flood conveyance, water management and other beneficial projects due to the methylmercury allocations and total mercury load limits. However, responsible parties must characterize their discharges and evaluate the feasibility of onsite controls for both methyl and total mercury. The Central Valley Water Board will consider the nature of the mercury sources, the feasibility of onsite controls, and the need to reduce methylmercury discharges when determining which responsible parties will be required to implement on-site control programs and/or participate in an offset program to maintain methylmercury allocations and total mercury load limits.

The recommended actions for methyl and total mercury source control are based on the current understanding of the methylation processes that are potentially controllable in the Delta. Factors controlling sediment methylmercury production have been the subject of intense scientific research (For reviews see Wiener and others (2003) and Benoit and others (2003)). Potentially controllable sediment factors and landscape events important in net methylmercury production include: amount of inorganic

Table 4.5: Summary of Recommended Implementation Actions and Timeline

TASKS	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015-2020
TMDL & Water Board Hearing Schedule											
Draft TMDL report to State Water Board and USEPA.		X									
Phase I Basin Plan Amendment Adoption Hearing.		X									
Phase I control program implementation.			X	X	X	X	X	X			
Staff report on Phase I assessment & control program status and updated TMDL allocations.									X		
Phase II Basin Plan Amendment Adoption Hearing.										X	
Phase II control program implementation.											X
Phase I Total Mercury Control											
Develop total mercury control programs for Putah Creek and American and Feather Rivers.		X	X	X	X	X	X	X	X	X	
Adoption Hearing for Cache, Bear, and Harley Gulch Basin Plan Amendment.	X										
Fund and implement maintenance excavation and improvements to Cache Creek Settling Basin.		X	X	X	X	X	X	X	X	X	X
Develop agency agreements with State Water Board, Air Resources Board, and USEPA to evaluate atmospheric mercury sources.			X	X	X						
Revise 401 Water Quality Certifications for dredge operations.			X	X	X	X	X	X	X	X	X
Adopt total mercury load caps and implementation schedules in NPDES facility and MS4 permits for permittees in the Delta and downstream of major dams.					X	X	X	X	X	X	X
Implement total mercury offset program.					X	X	X	X	X	X	X
Phase I Methylmercury Assessment											
Require NPDES facility and MS4 permittees in the Delta and within 30 miles upstream of the Delta to characterize their effluent and develop MeHg control options.			X	X	X	X	X	X			
Revise 401 Water Quality Certifications for dredge operations.			X	X	X	X	X	X	X	X	X
Conduct Delta Island loading study (contracted to Moss Landing Marine Laboratories).	X	X	X								
Require State Water Board, DWR, USBR, and USACE to characterize baseline MeHg production in open channels and evaluate effects of flow management practices on MeHg and sulfate concentrations.			X	X	X	X	X	X			
Characterize MeHg concentrations and loads from Cache Creek Settling Basin, agricultural lands, wetlands, and flood conveyance.			X	X	X	X	X	X			
Develop MeHg control programs for Mokelumne and Cosumnes Rivers and Yolo Bypass.			X	X	X	X	X	X			
Develop MeHg control programs for the lower American, Feather and Sacramento Rivers, Marsh and Putah Creeks and San Joaquin River and other small Delta tributaries.			X	X	X	X	X	X	X	X	X
Conditionally prohibit the discharge of MeHg into the Delta or its tributaries within 30 miles of the legal Delta boundary after 31 December 2014.											X
Monitor new water impoundments as necessary.		X	X	X	X	X	X	X	X	X	X
Phase I Reduction of Methylmercury Exposure to Fish Eating Public											
Conduct periodic fish tissue monitoring.	X						X				X
Reevaluate fishing advisory.			X								
Conduct Fish Contamination Outreach and Education Program.		X	X	X	X	X	X	X	X	X	X

mercury present in the sediment; amount of permanent or seasonally flooded wetland in a watershed; water rights and salt standards in the Delta; and creation of new water impoundments. These factors are described in detail in Chapter 3 of the TMDL Report. Many of the recommended implementation actions focus on these factors.

The actions outlined in the following sections would implement the recommended alternative, Alternative 3 described in Section 4.2.4. These actions and time schedules are designed to achieve the methyl and total mercury source load reductions described in Section 4.1, and thereby achieve the water quality objectives for Delta fish, as well as the San Francisco Bay Water Board allocation for total mercury leaving the Central Valley and the USEPA's CTR criterion for total mercury in the water column. Point sources of methyl and total mercury include discharges from NPDES facilities and MS4 permittees and from dredging operations. Nonpoint sources include return flow from Delta Islands and wetlands, diffusion from within-channel sediment production, runoff from urban areas not encompassed by the MS4s, and tributary inputs. The recommended actions for total mercury source reductions focus on nonpoint sources in tributary watersheds that export the most mercury-contaminated sediment as a means to control the amount of inorganic mercury present in the Delta sediments. However, the provisional source load estimates summarized in Section 4.1 suggest that reducing or eliminating any one source of methylmercury is unlikely to be a major factor in controlling ambient methylmercury concentrations in the Delta. Reductions must be made to both point and nonpoint methylmercury sources to decrease ambient concentrations to the proposed implementation goal for methylmercury in ambient water.

4.3.1 Methylmercury Source Characterization & Control Studies with Conditional Prohibition of Methylmercury Discharge

Although there is adequate scientific understanding to support a general allocation of responsibility for methylmercury reductions to different source categories (e.g., wetlands, NPDES facilities and MS4s), there is inadequate information available to support more detailed allocations to specific sources within several of the categories. In addition, effective ways to reduce methylmercury production need to be developed. As such, this implementation program includes a component to provide the needed studies to better characterize all major source concentrations and loads and to identify technically and economically feasible control options to reduce loads by the amounts specified in Section 4.1. All of the methylmercury control actions outlined in Sections 4.3.3 through 4.3.5 include requirements that responsible parties conduct source characterization and control studies during Phase I of this implementation program (Action Box #1 at the end of this section). Central Valley Water Board staff will work with responsible parties to develop study plans by 31 December 2007 that accomplish the objectives of the implementation program. Interim status reports would be due by 31 December 2009 and final reports by 31 December 2012. In January 2008 and January 2010, staff will report to the Central Valley Water Board on the responsible parties' progress towards compliance with the studies and management plan development.

The studies developed for each source category must identify and evaluate the following:

- Methyl and total mercury concentrations and loads in source waters and discharges (e.g., WWTP influent and effluent; agricultural irrigation water and return flows);
- Variables that control the creation or destruction of methylmercury, including diurnal and seasonal differences;

- Control mechanisms for those variables;
- Performance and cost of the most practical and effective control technologies and management practices; and
- Selection of preferred management practices and implementation schedule to reduce methylmercury concentrations and loads.

Source categories include: municipal and industrial wastewater treatment plants; urban runoff (both point and nonpoint sources); native and managed wetlands; flood conveyance; water management; and agriculture. To increase the efficiency and reduce the cost of the studies, it is recommended that responsible parties within each source category develop collaborative studies. However, individual parties may choose to submit their own plan, independent of any collaborative efforts. Responsible parties are identified by source category in the Action Boxes.

By January 2007, Central Valley Water Board staff – in consultation with stakeholders – will develop a fact sheet that provides guidance for developing study plans. By 31 December 2007, responsible parties will be required to submit a comprehensive study plan that addresses the information needs of this phased control program. Depending on how well the information needs are addressed by these study plans, who has participated in their development, and the level of assurances that the work will be completed, the Central Valley Water Board will use its authority under the Porter Cologne Water Quality Control Act Section 13267 (or alternately by General WDRs, NPDES permits, and 401 Certifications) to require, as needed, all the necessary components of a study plan that delivers the needed information by 31 December 2012. The results from these characterization and control studies, along with the data from other ongoing studies, will provide the information required for this phased implementation program. The Central Valley Water Board staff will review sampling and analysis plans for the various studies performed during this phase of the implementation program to ensure their adequacy in meeting the objectives of the individual studies and implementation program overall.

To support the source characterization and control studies described above, the State Water Board is requested to fund or conduct studies to develop and evaluate management practices to reduce methylmercury discharges from nonpoint sources. In addition, the Central Valley and San Francisco Bay Water Boards should conduct coordinated studies to evaluate methyl and total mercury loads that flux between the jurisdictional areas for future allocation revisions.

Based on the findings of the required and recommended studies, the Central Valley Water Board staff will develop detailed allocations for methylmercury sources in a revision to this TMDL by 31 December 2013. The Central Valley Water Board will consider the revised allocations and review the cost and efficacy of control methods in 2014. At that time, the Central Valley Water Board will determine whether to require implementation of the revised allocations upon renewal of point and nonpoint permits and conditional waivers during Phase II of this implementation program.

A proposed conditional prohibition of discharge can be utilized in concert with the phased implementation approach. The discharge of methylmercury into the Delta or its tributaries within 30 miles of the legal Delta boundary is conditionally prohibited after 31 December 2014, unless (1) the fish tissue mercury objectives for the Delta have been met, (2) methylmercury allocations have been met, (3) the methylmercury discharge concentration is less than 0.06 ng/l (or, for wetland and agricultural return waters, not greater than their source water methylmercury concentration), or (4) responsible parties

have conducted the characterization and control studies and implemented control actions in accordance with Central Valley Water Board adopted plans and schedules.

These prohibitions do not apply if: (a) the discharge is subject to a waiver of waste discharge requirements; (b) individual or general waste discharge requirements or NPDES permits implement the actions outlined in the following sections of this report or include as a finding that the discharge will have no reasonable potential to cause or contribute to a negative impact on the methylmercury levels in the Delta or its tributary waters within 30 miles of the Delta; or (c) the Central Valley Water Board finds that methylmercury control for a specific source is infeasible and either allows an offset project or waives the prohibition. The definition of reasonable potential is based on that given in the USEPA NPDES Permit Writers' Manual (USEPA, 1996, pgs. 99-104). The prohibitions together with the waste discharge requirements, NPDES permits, and waivers of waste discharge requirements will assure that all sources of methylmercury have been accounted for and that their impacts have been addressed. The timing of the prohibitions is such that adequate time is allowed to modify the control program and update WDRs, NPDES permits, and waivers of WDRs as needed. These prohibitions, along with possible revisions to the methylmercury allocations, will be reconsidered by the Central Valley Water Board in 2014 based on the results of characterization and control studies required as part of the phased implementation approach.

Methylmercury discharges from projects[19] completed between the Basin Plan amendment adoption date and 2014 are allowed so long as the discharge methylmercury concentration is less than 0.06 ng/l (or, for wetland and agricultural return waters, not greater than their source water methylmercury concentration), **or** responsible parties are participating in characterization and control studies in accordance with Central Valley Water Board adopted plans and schedules and exceedances are approved by the Executive Officer.

The Regional Board does not intend to impose a connection ban or limit growth due to the methylmercury limits. However, responsible parties must evaluate the feasibility of controlling methylmercury and either implement an on-site control program and/or participate in an offset program (see Section 4.3.2) to the extent feasible. The Central Valley Water Board will consider allowing a permittee to participate in an offset program to compensate for methylmercury loads in excess of the allocations if, after evaluating practices and potential implementation scenarios, dischargers have demonstrated that meeting the allocations is infeasible or impracticable. If meeting the allocations is infeasible for some sources, and no technically valid and legally defensible offset program can be developed, then the Central Valley Water Board may adjust the methylmercury allocations for several sources to focus more reduction efforts on sources with feasible control measures. Should an evaluation of implementation options indicate that water quality objectives protective of the Delta's beneficial uses cannot be reasonably attained given control technologies and management practices developed between 2006 and 2012, staff will reevaluate the Delta methylmercury TMDL. After 31 December 2014, all waste discharge requirements, permits and conditional waivers will be modified to reflect new methylmercury allocations and require implementation of control measures or participation in an offset program as needed.

[19] This recommendation applies to, but is not limited to, habitat restoration, water management and WWTP expansion projects planned for completion between 2006 and 2014.

Action Box#1: Methylmercury Source Characterization & Control Studies & Conditional Prohibition

Geographic Scope: Methylmercury sources within the Delta and its tributary watersheds 30 miles upstream of the Delta.

Responsible Parties: Public and private entities responsible for maintaining or reducing MeHg loading to the Delta or its tributary waterways within 30 miles of the legal Delta boundary. [Refer to Action Boxes 2 through 12 for lists of responsible parties.]

Strategy: Responsible parties accomplish the following:

- Complete methylmercury characterization and control studies to characterize methyl and total mercury concentrations and loads in source and receiving waters and discharges, identify variables that control methylmercury production, and estimate performance and cost of the most practical and effective control technologies and management practices; and
- Develop a management plan that describes practices that can be implemented to achieve the methylmercury allocations, a time schedule for practice implementation and, if applicable, detailed information documenting why fully achieving the allocations is infeasible.

Actions Required & Timeline:

- January 2007: Central Valley Water Board staff develops a study plan guidance fact sheet.
- December 2007: Responsible parties submit collaborative or individual characterization and control method study plans for each methylmercury source category. Source categories include: municipal and industrial wastewater treatment plants; MS4s; native and managed wetlands; flood conveyance; water management; and agriculture.
- January 2008: Staff reports to the Central Valley Water Board on the responsible parties' development of methylmercury characterization and control study plans.
- December 2009: Responsible parties submit interim status reports by 31 December 2009.
- January 2010: Staff reports to the Central Valley Water Board on the progress of the methylmercury characterization and control studies.
- December 2012: Responsible parties submit final study reports by 31 December 2012.
- 2013: Central Valley Water Board staff develops detailed allocations for MeHg sources in a TMDL revision.
- 2014: The Central Valley Water Board considers the revised allocations and reviews the cost and efficacy of control methods. Central Valley Water Board determines whether to require MeHg control implementation upon renewal of point and nonpoint permits and conditional waivers.
- December 2014: The discharge of MeHg into the Delta or its tributaries within 30 miles upstream of the legal Delta boundary is conditionally prohibited after 31 December 2014.

4.3.2 Mercury Offset Program

On-site mercury controls may not be technically or economically feasible for some sources. However, it is not a goal of the proposed Delta mercury control program to inhibit otherwise beneficial projects. The Central Valley Water Board may allow responsible parties to participate in an offset program *in lieu* of making on-site controls. An offset program would allow dischargers to offset methyl or total mercury loads in excess of requirements by implementing more feasible or cost effective projects elsewhere in the watershed. An offset program may be required to accomplish necessary methylmercury source caps and reductions if it is not technically or economically feasible for some responsible parties to decrease their methylmercury loading using on-site load controls to the extent necessary to achieve the water quality objectives throughout the Delta. In addition, it is expected that an offset program will be necessary for many new projects to achieve (a) no net increase in methylmercury concentrations in Delta waters and/or (b) no net increase in total mercury loading to Delta waters. Action Box #2 identifies the actions and time schedules assigned to the development of an offset program for the methyl and total mercury sources in the Delta and its tributary watersheds.

Staff makes the following general recommendations for the offset program:

- Offset projects should reduce methyl and/or total mercury loading from another part of the Delta where load reductions are not likely to occur in a reasonable amount of time (e.g., remediation or reduction projects where there are no readily identifiable or viable responsible parties).
- Offset projects should be allowed in watersheds where the Central Valley Water Board has either determined a mercury impairment exists that is a priority for cleanup or are on a list of acceptable projects (to be developed).
- To participate in the program, a responsible party should first conduct a study to evaluate all reasonable options for reducing on-site methyl and total mercury loads and demonstrate that it is technically infeasible and/or excessively expensive to achieve its methylmercury allocation and/or maintain its total mercury limit. The responsible party would present the results of its studies to the Central Valley Water Board and request to be considered for the offset program. The Central Valley Water Board would review the studies, including the required amount of on-site load reduction and associated cost, and weigh these against proposed off-site reductions and their likely environmental benefit. The Central Valley Water Board would then determine whether it was environmentally beneficial for the responsible party to participate in the offset program *in lieu* of making on-site methyl and/or total mercury load reductions.

The NPDES permit for the SRCSD's Sacramento River Wastewater Treatment Plant required it to evaluate the feasibility of implementing a total mercury offset program at their facility and to submit a technical report on the conclusions to the Executive Officer of the Regional Board, which SRCSD did. In addition, the State Water Board has contracted with Science Applications International Corporation (SAIC) to make recommendations on instituting a total mercury offset program in the Central Valley, with a report due in 2007.

Central Valley Water Board staff, in cooperation with State Water Board and USEPA staff, will review both the SRCSD and SAIC reports and use them as the basis for developing a mercury offset program. The offset program would be reviewed at a public workshop and presented to the Central Valley Water Board as part of a future Basin Plan Amendment. If adopted, the offset plan would serve as the framework for including mercury offsets in NPDES facility and MS4 permits, CWA 401 water quality

certifications, and other WDRs. The Central Valley Water Board will consider adoption of an offset program in 2009. Staff recommends that the first phase of the offset program make use of available information to focus on total mercury offset projects, and that the second phase of the offset program make use of information generated by the methylmercury characterization and control studies conducted between the effective date of this amendment and 2012 to incorporate methylmercury offset projects. The Central Valley Water Board would consider a methylmercury offset program in 2014.

Action Box #2: Mercury Offset Program

Geographic Scope: Delta and its tributary watersheds downstream of major dams.

Responsible Parties: Public and private entities assigned MeHg allocations and/or TotHg limits.

Source Control Strategy: Responsible parties may participate in an offset program *in lieu* of making on-site load reductions if they are unable to implement on-site TotHg or MeHg control measures due to technical or economic infeasibility.

Actions Required & Timeline:

- 2005 to 2007: SAIC conducts study funded by the State Water Board to develop the framework of a TotHg offset program for the Central Valley.
- 2007-2009: USEPA and State and Regional Water Board staff uses the 2005 SRCSD report and the 2007 SAIC report to draft a mercury offset plan. The draft offset plan will be reviewed at a public workshop and presented to the Central Valley Water Board as a potential Basin Plan amendment. If adopted by the Board, the offset program would serve as the framework for including MeHg or TotHg offsets in NPDES facility and MS4 permits and 401 water quality certifications.
- 2009 onward: As necessary, responsible parties obtain Central Valley Water Board approval and initiate TotHg offset projects using available information about TotHg mercury sources in the Delta's tributary watersheds and known TotHg control methods.
- 2013: Central Valley Water Board staff develops detailed alternatives for MeHg sources allocations and implementation options in a TMDL revision based on the results of the MeHg characterization and control studies described in Action Box #1.
- 2014: The Central Valley Water Board considers the revised MeHg allocations and reviews the feasibility and efficacy of control methods. Central Valley Water Board determines whether to amend the Basin Plan and require MeHg control implementation upon renewal of point and nonpoint permits and conditional waivers.
- 2014 onward: As necessary, responsible parties obtain Central Valley Water Board approval and initiate MeHg offset projects.

4.3.3 Actions Addressing Point Sources

Point sources of methyl and total mercury in the Delta and its tributaries include discharges from NPDES facility and MS4 permittees and from dredging operations. Actions for each are described in separate action boxes at the end of this section.

Municipal & Industrial Facilities: All facilities that discharge pollutants to surface waters in the Delta and its source region are regulated by either individual or general NPDES permits from the Central Valley Water Board. Tables B and C in the proposed Basin Plan amendment language list the permitted facilities assigned methylmercury allocations and total mercury limits by name and permit number. Action Box #3 identifies the actions and time schedules assigned to these facilities.

There are 20 facilities in the Delta with individual permits. In addition, there are 45 permitted facilities within 30 miles of the legal Delta boundary, and another 64 facilities that are downstream of major dams. Table 4.6 lists the number of different types of facilities by geographic region. Methylmercury allocations apply to facility discharges in the Delta and within 30 miles upstream of the Delta. Methylmercury allocations do not apply to power and heating/cooling facilities because they do not appear to act as sources of methylmercury to the Delta (see Section 6.2.3 and Appendix G in the TMDL Report). Facilities that discharge greater than 1 mgd and are assigned methylmercury allocations are required to complete methylmercury characterization and control studies (see Section 4.3.1). Total mercury limits apply to facility discharges in the Delta and its tributary watersheds downstream of major dams. Power, heating/cooling and aquaculture facilities, which account for about 50% of the volume discharged by facilities to the Delta source region, do not appear to act as sources of total mercury to the Delta (see Section 7.1.2 and Appendix G in the TMDL Report). In addition, facilities that discharge greater than 1 mgd account for about 97% of the volume discharged by facilities to the Delta source region. Therefore, total mercury limits do not apply to power, heating/cooling and aquaculture facilities or to facilities that discharge less than 1 mgd.

Urban Runoff: There are about 60,000 acres of urban land in the Delta. In addition, there are more than 370,000 acres of urban land within 30 miles of the Delta and another ## acres downstream of major dams. Methylmercury allocations and total mercury limits for urban runoff will be implemented through NPDES Municipal Separate Storm Sewer Systems (MS4) permits issued to urban runoff management agencies in the Delta and its source region downstream of major dams. The urban runoff methylmercury allocations and total mercury limits implicitly include all current and future urban discharges within MS4 service areas not otherwise addressed by other allocations within the geographic boundaries of urban runoff management agencies, including but not limited to Caltrans roadway and non-roadway facilities and rights-of-way, public facilities, properties proximate to banks of waterways, industrial facilities, and construction sites.

Methylmercury allocations apply to Phase I and II MS4s in the Delta or within 30 miles of the Delta (see Table D in the proposed Basin Plan amendment language). Phase I permittees, which include the Sacramento, Stockton, Contra Costa County, and Modesto area permits, must complete methylmercury characterization and control studies (see Section 4.3.1). Total mercury limits apply to Phase I and II MS4s in the Delta and within its tributary watersheds downstream of major dams (see Table E in the proposed Basin Plan amendment language). Action Box #4 summarizes the actions and time schedules assigned to MS4s.

Dredge Operations: Portions of the Delta are depositional in nature. As a result, about 304 Mkg of sediment are removed each year on average for maintenance of navigation channels and marinas. Recent dredge projects within the Delta have taken place in the Sacramento River Deep Water Ship Channel, Stockton Deep Water Channel, Village West Marina, Korths Pirates Lair, Big Break Marina, Sportsman Yacht Club, and Discovery Bay. The Sacramento and Stockton deep water channels have annual dredging programs; the locations dredged each year vary. Dredging occurs at other Delta locations when needed, when funds are available, or when special projects take place. Approximately 533,400 cubic yards of sediment are dredged annually on average, with 199,000 cubic yards from the Sacramento Deep Water Ship Channel and 270,000 cubic yards from the Stockton Deep Water Channel. Other minor dredging projects at marinas remove sediment at various frequencies for a combined total of about 64,400 cubic yards per year. Dredge material is typically pumped to either disposal ponds on Delta islands or upland areas with monitored return flow. As described in Chapters 6 and 7 of the TMDL

Table 4.6: Types of Permitted Facilities in the Delta Source Region

Facility Type	Proximity to Delta / Flow Category						Grand Total
	Within Delta		Within 30 Miles of the Delta		Downstream of Major Dam		
	< 1 mgd	> 1 mgd	< 1 mgd	> 1 mgd	< 1 mgd	> 1 mgd	
# of Facilities							
Aggregate		1			2	1	**4**
Aquaculture			1	4		14	**19**
Food				1	4		**5**
Heating/Cooling		2	1	1	1		**5**
Landfill			1				**1**
Manufacturing			1	1			**2**
Mine					1		**1**
Paper Mill					4	1	**5**
POTW	6	8	5	13	17	14	**63**
POTW (Comb.)		1					**1**
Power	1	1	2	2	1	1	**8**
WTP (GW)			5	4	1	1	**11**
Other			3		1		**4**
Total #:	**7**	**13**	**19**	**26**	**32**	**32**	**129**
Volume Discharged (mgd)							
Aggregate		9.2			0.002	3.9	**13.0**
Aquaculture			0.10	67.5		169.5	**237.1**
Food				1.0	1.2		**2.2**
Heating/Cooling		10.3	0.024	1.5	0.34		**12.2**
Landfill			0				**0.0**
Manufacturing			0.88	5.5			**6.4**
Mine					0.05		**0.05**
Paper Mill					0.74	1.9	**2.6**
POTW	1.2	207.5	0.36	67.1	5.5	49.0	**330.7**
POTW (Comb.)		1.3					**1.3**
Power	0.05	123.9	0.64	14.8	0.02	1.1	**140.5**
WTP (GW)			0.60	10.5	0.7	1.6	**13.4**
Other			0.36		0.25		**0.61**
Total Volume (mgd):	**1.2**	**352.2**	**3.0**	**167.9**	**8.8**	**226.9**	**760**

(a) POTW: Publicly owned treatment works; POTW (Comb.): Combined sewer system; GW: Groundwater treatment facility.

Report, no data have been gathered on methylmercury levels in dredge material removed from the Delta or in return waters, and provisional analyses indicate a substantial amount of uncertainty in the total mercury load removed by dredging activities.

Action Box #5 identifies the actions and time schedules assigned to dredge operations. Under Clean Water Act (CWA) Section 404, any project that proposes to discharge fill or dredged material into a water of the United States must obtain a permit from the U.S. Army Corps of Engineers (USACE). If such a project has the possibility to affect water quality, project proponents must also apply for a Water Quality Certification under Section 401 of the CWA. In California, the Central Valley Water Board is responsible for providing these CWA Section 401 certifications (CWC § 3830-3869), which are enforceable orders under California law. In order to issue a CWA Section 401 certification, the Central Valley Water Board must find that the project will, in accordance with the Basin Plan, protect beneficial uses, comply with numeric water quality objectives, and not violate the anti-degradation policy of State Water Board Resolution No. 68-16. The Central Valley Water Board may impose conditions in a CWA Section 401 certification to comply with the CWA, California Water Code, and other applicable laws, as necessary. All dredging in the Delta requires a 401 water quality certification from the Central Valley Water Board. In addition to CWA Section 401 certifications, the Central Valley Water Board can issue waste discharge requirements for dredging operations. Future 401 certifications will require characterization of methyl and total mercury concentrations in dredged material and exposed sediment surfaces and erosion control requirements.

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Action Box #3: NPDES-Permitted Municipal & Industrial Facilities

Geographic Scope: NPDES-permitted municipal and industrial facilities within the Delta and its tributary watersheds downstream of major dams.[(a)]

Responsible Parties: Municipal, State and Federal agency and industrial permittees identified in Tables B and C in the proposed Basin Plan amendment language.

Source Control Strategy for Methylmercury:

- Assign MeHg allocations to facilities in the Delta or within 30 miles upstream of the Delta based on facility 2005 discharge volumes and facility-specific average effluent MeHg concentration observed in 2004-2005:
  - Cap MeHg concentrations in facility discharges with MeHg concentrations below the proposed implementation goal of 0.06 ng/l. Discharge volumes and loads from such sources would be allowed to increase so long as their MeHg concentrations do not increase.
  - Cap MeHg concentrations and loads in facility discharges with MeHg concentrations above the proposed implementation goal that discharge to waterways that achieve the proposed implementation goal. The discharge volume of a particular facility would be allowed to increase so long as the MeHg load does not increase.[(b)] If individual facilities increase their volume without maintaining these allocations, the associated increase in MeHg loading must be mitigated.
  - Reduce MeHg concentrations and loads in facility discharges with MeHg concentrations above the proposed implementation goal that discharge to Delta waterways that do not achieve the proposed implementation goal by the amount needed to achieve the proposed implementation goal in the Delta receiving water. The discharge volume of a particular facility would be allowed to increase so long as the allocated load (after reduction is achieved) does not increase. If individual facilities increase their volume without maintaining these allocations, the associated increase in MeHg loading must be mitigated.
  - No facility would be expected to reduce its discharged MeHg concentrations to below the proposed implementation goal.
- Require facilities that discharge greater than 1 mgd to complete MeHg characterization and control studies and submit management plans by 2012 (refer to Action Box #1) ***or*** to achieve MeHg allocations by 2014. Smaller facilities are encouraged to coordinate and cooperate in the studies.
- Prohibit new or expanded discharges proposed to begin between the effective date of this amendment and 2014 unless the discharge is less than 0.06 ng/l MeHg or the discharger participates in the control studies and discharges above 0.06 ng/l are approved by the Executive Officer. New discharges that begin after the effective date of this amendment may necessitate adjustments to the allocations.
- Implement on-site MeHg control actions at existing facilities and/or MeHg offset projects (see Action Box #2) after 2014 based on the results of the control studies and Central Valley Water Board approval of proposed management plans. Implement on-site MeHg control actions or offset projects to mitigate MeHg loading from new or expanded facilities completed after 2014 that causes the average annual concentration of the facilities to exceed the proposed implementation goal of 0.06 ng/l MeHg.

Source Control Strategy for Total Mercury:

- Cap TotHg loads from all facilities in the Delta and downstream of major dams that discharge greater than 1 mgd at their 2008 loads. Until a final offset program is adopted by the Central Valley Water Board, these facilities are in compliance with the total mercury limits if they (1) implement a Pollution Prevention Plan for TotHg in compliance with Section 13263.3 of the California Water Code and maintain compliance with a USEPA approved pretreatment program, as applicable, and, if discharging prior to 2006 (2) does not exceed the 2006 annual average mercury concentration.[(c)] Facilities that discharge less than 1 mgd are required to implement a Pollution Prevention Plan for TotHg and maintain compliance with a USEPA approved pretreatment program, as applicable.
- A mercury offset program is anticipated for Central Valley Water Board consideration in 2009 (see Action Box #2). In the absence of a mercury offset program, the 2008 TotHg load limits would continue to be in effect. After 2008, the Executive Officer would evaluate new NPDES facilities on an individual basis when establishing TotHg load limits in permits.
- Allow no net increase in TotHg loading to the Delta or its tributary watersheds downstream of major dams from new or expanded facilities completed after 2008. Dischargers whose TotHg loads exceed the 2008 load limit shall maintain a Pollution Prevention Plan and offset the excess TotHg in subsequent years in conformance with the final mercury offset program, or reduce their loads to surface waters either by additional treatment, pretreatment, or removal of wastewater flow by expanded reclamation to land.

Action Box #3: NPDES-Permitted Municipal & Industrial Facilities *continued*

Actions Required & Timeline:

- 2007: Central Valley Water Board requires facilities that discharge >1 mgd to submit study plans for the development of MeHg control methods to reduce effluent MeHg concentrations and the evaluation of mitigation options by 31 December 2007. Study plans may be coordinated through the Central Valley Clean Water Association or other collaborative or individual facility efforts.
- 2007 to 2012: Responsible parties conduct MeHg control studies and submit interim progress reports by 31 December 2009 and final reports by 31 December 2012.
- 2009: Facilities that discharge greater than 1 mgd in the Delta and downstream of major dams report their 2008 TotHg loads by 31 March 2009.[(d)]
- 2007 to 2014: New or expanded MeHg discharges proposed to begin between the effective date of this amendment and 2014 are prohibited unless the discharge has an annual average MeHg concentration less than 0.06 ng/l or the discharger participates in the control studies and discharge concentrations above 0.06 ng/l are approved by the Executive Officer.
- 2009 onward: New and renewing permits will be modified to reflect TotHg load caps and to require implementation of total mercury control measures or participation in an offset program.
- 2013: Central Valley Water Board staff updates TMDL MeHg source analysis and drafts a new proposed Basin Plan amendment with revised MeHg allocations based on the results of the MeHg characterization and control studies.
- 2014: Central Valley Water Board reviews cost and efficacy of MeHg control studies and determines whether to require their implementation in new and renewing permits. If on-site control methods are not technically or economically feasible, the Board then evaluates other mitigation options to achieve the water quality objectives for mercury in Delta fish, including an offset program for MeHg. Central Valley Water Board considers amendment of MeHg allocations and implementation plan in Basin Plan to reflect required MeHg control measures.
- December 2014: The discharge of MeHg into the Delta or its tributaries within 30 miles upstream of the legal Delta boundary is conditionally prohibited after 31 December 2014 (see Action Box #1).
- 2015 onward: Central Valley Water Board requires MeHg control measures in new and renewing permits with compliance schedules for implementation as needed.

(a) Major reservoirs and lakes in the Sacramento Basin include Shasta, Whiskeytown, Oroville, Englebright, Camp Far West, Folsom/Natoma, and Black Butte, Indian Valley, Clear Lake and Lake Berryessa. Major reservoirs and lakes in the San Joaquin Basin include Camanche, New Hogan, New Melones/Tulloch, Don Pedro, McClure, Burns, Owens, Eastman, Hensley, Millerton and Marsh Creek.

(b) For example, an increase in volume would necessitate a decrease in MeHg concentration to maintain the load allocation so that the increased volume does not cause an increase in receiving water MeHg concentration.

(c) Annual loads are calculated by the summation of monthly concentrations multiplied by monthly flows. Monthly concentrations are an average of all effluent concentration data collected that month. Non-detect measurements should use one-half of the detection level (minimum detection level 0.2 ng/l) for the calculations.

(d) Annual average concentration shall be average of monthly averages. Monthly averages are the mean of all data collected during a given month.

Action Box #4: Urban Runoff

Geographic Scope: Urban discharges within the Delta and its tributary watersheds downstream of major dams encompassed by MS4 service areas and not otherwise addressed by other allocations within the geographic boundaries of urban runoff management agencies, including but not limited to Caltrans roadway and non-roadway facilities and rights-of-way, public facilities, properties proximate to banks of waterways, industrial facilities, and construction sites.

Responsible Parties: MS4 permittees identified in Tables D and E in the proposed Basin Plan amendment language.

Source Control Strategy:

- Assign MeHg load allocations to MS4 discharges in the Delta or within 30 miles upstream of the Delta. Base allocations on (1) average MeHg concentrations in wet and dry weather Delta region urban runoff[(a)] and WY2000-2003 annual average runoff volume, and (2) amount of reduction needed from MeHg sources to achieve the proposed implementation goal of 0.06 ng/l in Delta waters. No MS4 would be expected to reduce its discharge MeHg concentrations to below the proposed implementation goal.
- Cap TotHg inputs from all MS4s in the Delta and downstream of major dams. Total mercury limits for MS4 discharges would be the 10-year annual average mercury load calculated for 2002 through 2011. Annual total mercury loads should be calculated by the average total mercury concentration measured in urban runoff times annual average runoff volume for 2002 through 2011, or alternate method approved by the Executive Officer.
- Require Phase I MS4s to complete by 2012 MeHg and TotHg characterization and control studies as part of their required mercury control plans to be included in their Storm Water Pollution Prevention Plans. Phase II MS4s are encouraged to coordinate and cooperate in the studies.
- As specified by Central Valley Water Board's review of study results and proposed TMDL revisions in 2014, Phase I and II MS4s would be required to implement on-site best management practices and control measures as identified the MS4 Storm Water Pollution Prevention Plans to (a) reduce MeHg discharges to comply with MeHg allocations for existing urban areas, and (b) prevent the increase of TotHg loading from existing urban developments. New urban developments in Phase I and II MS4 service areas would incorporate MeHg and TotHg management practices.
- The Central Valley Water Board may allow MS4 Phase I and II dischargers to participate in TotHg or MeHg offset projects (see Action Box #2) if (a) the mercury control studies indicate that on-site management practices are unable to achieve MeHg allocations and/or maintain TotHg caps for existing MS4 discharges, or (b) the mercury control pilot studies are unable to demonstrate that new developments will not increase net TotHg loading to the Delta or net MeHg concentrations in Delta waters. In the absence of an approved mercury offset program, MS4s will be in compliance with the Delta mercury control program if they complete and implement approved mercury control programs in their storm water management programs that minimize MeHg and TotHg in runoff to the maximum extent practicable.
- Assign methylmercury allocations to urban areas (including industrial and construction discharges) that are not regulated by MS4s in 2014.
- Total mercury limits apply to Phase I and II MS4 discharges within the Delta and in tributaries to the Delta downstream from major dams.

Continued on next page.

Action Box #4: Urban Runoff *continued*

Actions Required & Timeline:

- 2007: Central Valley Water Board requires Phase I MS4s to submit by 31 December 2007 the MeHg and TotHg characterization and control study plans for the development of best management practices to achieve MeHg allocations and maintain TotHg load caps. Study plans may be coordinated through the California Stormwater Quality Association or other collaborative or individual MS4 efforts.
- 2007 to 2012: Phase I MS4s conduct studies and submit interim progress reports by 31 December 2009 and final reports by 31 December 2012.
- 2013: Central Valley Water Board staff updates TMDL MeHg and TotHg source analyses and implementation strategies using data supplied by the Phase I MS4 studies and other permit-required monitoring efforts and drafts a new proposed Basin Plan amendment with revised MeHg allocations and TotHg limits.
- 2014: Central Valley Water Board reviews cost and efficacy of TotHg and MeHg control studies and determines whether to require on-site implementation of control measures upon renewal of permits for Phase I and II MS4s. If on-site control methods are not technically or economically feasible, the Board then evaluates other mitigation options to achieve the Delta WQO, possibly including an offset program. The Board considers amendment of MeHg allocations, TotHg limits and mercury implementation plan in Basin Plan to reflect improved load estimates and required control measures.
- December 2014: The discharge of MeHg into the Delta or its tributaries within 30 miles upstream of the legal Delta boundary is conditionally prohibited after 31 December 2014 (see Action Box #1).
- 2015 onward: Central Valley Water Board requires MeHg and TotHg control measures in new and renewing permits with compliance schedules for implementation as needed.

(a) The MeHg allocations for all MS4s are based on load estimates calculated using regional average methylmercury concentrations for wet and dry weather. Once additional information is available from the proposed characterization and control studies, the Central Valley Water Board may choose to update the allocations using an outfall-specific approach similar to the reduction strategy proposed for the NPDES facilities (see Action Box #3).

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Action Box #5: Dredge Operations

Geographic Scope: Dredging activities within the Delta.

Responsible Parties: Dredging projects that require Clean Water Act 401 Water Quality Certifications.

Source Control Strategy: Cap MeHg and TotHg loads to Delta waterways resulting from dredge activities.

Actions Required & Timeline:

- 2007 onward: Central Valley Water Board adds conditions in 401 Water Quality Certifications for characterization and control measures in new and renewing permits:
  - Characterize TotHg and MeHg loads removed from Delta waterways by dredge activities.
  - Conduct before-and-after surface sediment monitoring to ensure that newly-exposed sediment has an average total mercury concentration less than the surface material before dredging.
  - Employ management practices during and after dredging activities to minimize sediment releases into water column.
  - Ensure that disposal of dredged material with average total mercury concentrations greater than 0.2 mg/kg (dry weight, fines < 63 microns), is protected from erosion by 100 year precipitation or flow conditions.
  - Ensure that return flows from the disposal of dredged material do not have MeHg concentrations greater than the receiving water concentration.

4.3.4 Actions Addressing Nonpoint Sources

The majority of the methyl and total mercury in the Delta is produced by nonpoint sources in the Delta and its tributary watersheds. As described in the TMDL Report, approximately 96% of total mercury loading to the Delta comes from the tributary watersheds. Major nonpoint sources of total mercury in the tributary watersheds include historic gold and mercury mine sites in the Sierra Nevada and Coastal Ranges, legacy mercury in the channels released by historic mining operations, naturally mercury-enriched soils, geothermal springs and atmospheric deposition. About 66% of methylmercury loading in the Delta results from tributary inputs and about 34% from within-Delta sources, predominately nonpoint sources. Major nonpoint sources of methylmercury in the Delta may include return flows from Delta islands and wetlands, flood conveyance flows in the Yolo Bypass, and diffusion from sediment located in open water areas. Similar nonpoint sources likely contribute to the methylmercury in tributary inputs to the Delta. The relative magnitude of these contributions make it unlikely that decreases in ambient methylmercury levels in the Delta can be achieved without requiring nonpoint source reductions. Actions for each nonpoint source category are described in separate action boxes at the end of this section.

Sediment Flux of Methylmercury from Existing Native and Managed Wetlands: Action Box #6 identifies the actions and time schedules assigned to responsible parties for native and managed wetlands, including duck club ponds. Staff will identify private and public entities responsible for the native and managed wetlands as the first step of implementing the Delta mercury control program approved by the Central Valley Water Board.

Research conducted in the Delta and elsewhere has found that seasonally and permanently flooded wetlands are efficient sites for methylmercury production (see Chapter 3 in the TMDL Report). There are

about 20,000 acres of wetlands in the Delta and about another 20,000 acres within 30 miles of the Delta. The Record of Decision for the California Bay-Delta Authority commits it to restore between 39,000 and 54,300 acres of seasonal and permanent wetlands in the Bay-Delta Estuary. This represents about a doubling in wetland acreage in the Delta. Many marsh restoration actions in the Delta require a Section 401 water quality certification from the Central Valley Water Board. In addition, managed wetlands will be regulated by the Central Valley Water Board's Irrigated Lands Conditional Waiver program (Central Valley Water Board, 2003).

The largest acreage of marsh in the Delta is located in the Yolo Bypass.[20] The Yolo Bypass was constructed as a floodwater conveyance system to divert flood flows from the Sacramento Valley around the City of Sacramento. Prospect Slough, downstream of the Cache Creek Settling Basin in the Yolo Bypass, has the highest annual average methylmercury concentration of any location in the Delta (see Table 6.3 in the TMDL Report). Ongoing studies suggest that much of the methylmercury in Prospect Slough is produced in local marshes, particularly when the Yolo Bypass receives flood flow from Cache and Putah Creeks and from the upper Sacramento River through Fremont Weir (C. Foe, personal communication). Wetland managers will be required to conduct studies to determine how the wetlands might be managed to minimize methylmercury production and encouraged to coordinate their studies with each other and the flood control agencies. Effective management practices for reducing methylmercury production from wetlands have not yet been developed and may not be precisely identified until the studies are completed. However, it is expected that it will be possible to reduce methylmercury exports from wetlands because of data from similar wetlands showing differences in methylmercury fluxes and fish tissue concentrations (See Chapter 4.2.3). It may not be feasible to reduce methylmercury production from wetlands sufficiently to meet the recommended aqueous methylmercury goal in the Yolo Bypass. The total mercury content of sediment is one factor controlling methylmercury production (Chapter 3 in the TMDL Report). Therefore, if the studies conclude that adequate methylmercury reduction within the wetlands is not feasible, responsible parties, as mitigation for discharging excessive methylmercury concentrations, may be allowed to evaluate other factors such as the reduction of total mercury loading from the Cache Creek Settling Basin.[21]

Flood Conveyance: Action Box #7 identifies the actions and time schedules assigned to responsible parties for the Yolo Bypass. As noted in the previous paragraphs, ongoing studies suggest that much of the methylmercury in Prospect Slough is produced in local marshes when the Yolo Bypass receives flood flow from Cache and Putah Creeks and from the upper Sacramento River through Fremont Weir. Flood control agencies are therefore encouraged to enter into cooperative agreements with wetland managers to conduct studies to determine how the wetlands might be operated to minimize methylmercury production. If the studies conclude that there are no feasible management practices capable of reducing methylmercury levels by the required amounts, responsible parties may be allowed to evaluate mitigation

[20] The established marshes are owned by the California Department of Fish and Game and by private parties. Several State and federal agencies also have recently purchased property in the Yolo Bypass and are in the process of converting it to wetlands.

[21] The precise amount of increased trapping efficiency needed in the Cache Creek Settling Basin to reduce total mercury concentration in downstream sediment and the resulting methylmercury production is not known. The Cache Creek Settling Basin traps about 50% of sediment and total mercury that enters it from the Cache Creek watershed. On average, the basin receives ~250 kg/yr from the Cache Creek watershed and discharges about 125 kg/yr to the Yolo Bypass. The staff's best professional judgement is that an increase in Settling Basin trapping efficiency to 80 to 90% may be required (e.g., a decrease in exports from 125 kg/yr to 50 to 25 kg/yr of total mercury). Studies could be conducted to improve this estimate.

options such as the modification or enlargement of the Cache Creek Settling Basin to reduce total mercury exports to downstream marshes.

Because Yolo Bypass geometry does not discharge any methylmercury *per se*, no waste load or load allocation is currently assigned to entities responsible for the bypass. However, if flood flows were not routed down the bypass, the wetlands and other lands in the bypass would not discharge methylmercury to the Delta. As a result, the Central Valley Water Board will require that the cumulative effects on methylation in bypass wetlands caused by flood flows be adequately studied and, if possible, mitigated. In addition, no net increase in methyl or total mercury loading compared to previous land use discharges will be allowed from new or expanded flood conveyance projects. CWA Section 401 certification would require such projects to conduct before-and-after monitoring and to provide adequate mitigation for any negative impacts on methyl and total mercury loading.

Methylmercury in Delta Islands/Agricultural Return Flows: The Delta is composed of 65 islands and tracts on about three-quarters of a million acres of land. Agriculture is the main land use, comprising more than half of a million acres. In addition, there are nearly two million acres of agricultural lands within 30 miles of the Delta. Action Box #8 identifies the actions and time schedules assigned to responsible parties. Staff will identify responsible landowners as the first step of implementing the Delta mercury control program approved by the Central Valley Water Board. Agricultural operations are regulated by the Central Valley Water Board's Irrigated Lands Conditional Waiver Program.

Limited methylmercury data are available for Delta island agricultural return flows. Preliminary sampling conducted during the summer of 2000 in five Delta island main drains indicates that the islands are a net source of methylmercury. The State Water Board has funded a study with Moss Landing Marine Laboratories (Contract 04-235-150-0) to characterize methylmercury concentrations and loads from representative drains and to use the results to determine the overall contribution of the islands to the methylmercury mass balance of the Delta. The study also will determine land use practices that contribute disproportionately to annual methylmercury loads from one Delta island. The latter may prove valuable in identifying and focusing management practices on key land use practices. The study is being conducted in cooperation with local Reclamation Districts and should be completed in 2007. If study results indicate that annual average methylmercury concentrations exceed the recommended implementation goal for methylmercury in ambient water, then responsible parties will be required under the Central Valley Water Board's Irrigated Lands Conditional Waiver Program to undertake studies to characterize agricultural source and return waters and determine management practices to reduce loads. Responsible parties are encouraged to use a watershed approach to coordinate the studies. The Central Valley Water Board will consider requiring responsible parties to implement feasible management practices in Phase II of the implementation program.

Sediment Flux of Methylmercury from Open Water Habitats: The Delta has more than 48,000 acres of open water (Table 6.4 in the TMDL Report). Associated bottom sediments are estimated to produce about 15% of the annual Delta methylmercury load. Methylmercury production in sediment has often been found to be a function of pore water sulfate concentrations (Chapter 3 in the TMDL Report). Two factors influencing sulfate concentrations in the Delta are the water quality objectives for electrical conductivity and the construction of water barriers in the southern Delta. Water Rights Decision 95-1WR specifies maximum ambient electrical conductivity values for various locations in the Delta by month and water year type. Sulfate concentrations are strongly a function of electrical conductivity. As a result,

Water Rights Decision 95-1WR also regulates sulfate concentration and therefore may influence sediment methylmercury production rates.

The second water management decision that may affect methylmercury production in the Delta is the Record of Decision for the Bay-Delta Authority. The Record of Decision commits the Authority to evaluate and, if practical, construct a series of permanent barriers in the southern Delta as part of the South Delta Improvement Project (SDIP). This project is intended to mitigate the water supply and water quality impacts associated with increasing the maximum allowable diversion capacity into Clifton Court Forebay, from which the State Water Project pumps its water. One of the alternatives being considered as mitigation for the effects of increased diversion is the installation of operable flow control barriers at the head of Old River and other locations in the southern Delta. These barriers will act to reduce the amount of San Joaquin River flow being diverted down Old River towards the pumps and away from the San Joaquin River near Stockton. Operation of the permanent barriers would control the ratio of San Joaquin to Sacramento River water in much of the southern Delta. Sulfate concentrations in the San Joaquin are about seven times higher than in the Sacramento River. Therefore, operation of the permanent barriers could exert a strong influence on sediment sulfate concentrations in the southern Delta and may influence ambient methylmercury levels. In addition, because the SDIP will involve dredging in some southern Delta channels and construction of other in-stream structures, a CWA Section 404 permit from the USACE and a CWA Section 401 certification from the Central Valley Water Board will be required. In order to obtain this certification, the SDIP will need to provide adequate mitigation measures on a specific implementation timeline for the potential impacts of the project on methylmercury conditions in the southern Delta, dissolved oxygen conditions in the Stockton Deep Water Ship Channel, and any other water quality concerns. The Central Valley Water Board will use this authority to ensure the potential impacts of this project on ambient methylmercury levels in the Delta are properly evaluated and mitigated.

Action Box #9 identifies the actions and time schedules assigned to responsible parties for water management in the Delta and its source region. Responsible parties are required to conduct studies to evaluate the effect of water management practices on ambient water column methylmercury concentrations in the Delta. In particular, it is recommended that responsible parties conduct sulfate amendment studies to determine whether sulfate concentrations affect methylmercury production rates and resulting ambient water column concentrations in the Delta. If the results show that existing water management decisions (or changes to the decisions) affect ambient methylmercury levels, then responsible parties may be required to develop and implement feasible management measures to minimize impacts. The responsible parties may also propose mitigation measures. For Phase I of the proposed mercury implementation program for the Delta, the annual methylmercury load produced by sediment flux in the Delta is capped. However, the Central Valley Water Board will review the results of the studies and may recommend that responsible parties implement any feasible management or mitigation actions during Phase II of the implementation program. The Central Valley Water Board could require mitigation for activities that affect methylation rates in the Delta. In addition, the State Water Board could use its water rights authority for existing activities that affect methylation rates in the Delta to require that the associated impacts be evaluated and their impacts reduced.

Urban Areas Not Included in MS4s: Discharges from urban areas that are not currently subject to Phase I or Phase II of the NPDES storm water program are not required to obtain NPDES permits (see 33 U.S.C. §1342(p)(1) & (p)(6)). Therefore, for regulatory purposes, they are analogous to nonpoint sources (see 40 C.F.R. § 130.2(g)). Available information indicates within-Delta urban areas outside of

MS4 service areas comprise less than 4% of all urban acreage and associated urban methylmercury loading to the Delta. Urban areas outside of MS4 service areas in the Delta's tributary watersheds comprise a similarly small percentage. As a result, they will not be assigned methylmercury allocations until 2014, after the completion and review of Phase I MS4 mercury characterization and control studies. If such urban areas expand significantly, or are found to be significant contributors of mercury or other pollutants, they will be designated Phase II MS4 dischargers and required to develop and implement mercury control plans like those proposed for existing Phase II dischargers.

Atmospheric Deposition: Atmospheric deposition of mercury in the Delta and its tributary watersheds needs to be capped at existing levels. Atmospheric deposition is a statewide issue and some sources originate outside of the state. Staff recommends that a memorandum of understanding (MOU) be developed between USEPA, the State Water Board, and the Air Resources Board to conduct studies to evaluate local and statewide air emissions and deposition patterns, and to develop and implement a load reduction program(s) if necessary. Action Box #10 identifies the actions and time schedules recommended for oversight agencies for regional and statewide air emissions.

Results of ongoing studies on atmospheric deposition of mercury in the Delta have not yet been published. Provisional estimates calculated for the TMDL indicate that wet deposition within the Delta contributes approximately 1% of all total mercury entering the Delta. Indirect wet deposition and runoff from the Central Valley to the Delta is more uncertain but may be significant because of the immense acreage of the Delta's tributary watersheds. For example, runoff from indirect deposition may contribute as much as 23 to 69% of the total incoming mercury load to the Delta during water year 2001 (Foe, 2003). Texas A&M University researchers are currently conducting a study as part of the ongoing CalFed-funded project (ERP-02-C06-B) to measure methyl and total mercury in atmospheric deposition at sites in the Sierra Nevada Mountain Range, Coastal Range, and Delta. The study should be completed and a report prepared in late 2006.

In an attempt to identify local – and therefore potentially controllable – sources of mercury in atmospheric deposition in the Delta and its tributary watersheds, mercury loads emitted by facilities that report emissions to the California Air Resources Board were reviewed in Appendix K of the TMDL Report. The 2002 data indicate that almost 10 kg of total mercury was released in the Delta by sugar beet facilities, electric services, paper mills, feed preparation, and rice milling. Cement and concrete manufacturing facilities and crematories in the Delta's tributary watersheds appear to have relatively high mercury emissions. Local air emissions of mercury warrant additional research.

Tributary Watershed & Cache Creek Settling Basin Inputs: Action Boxes #11 and #12 identify the actions and time schedules assigned to the development of control programs for tributary inputs to the Delta. Tributary inputs to the Delta account for more than 96% of total mercury loading and approximately 60% of methylmercury loading. Achievement of the proposed water quality objective for mercury in Delta fish, and compliance with the San Francisco Bay Water Board's requirement for a 110 kg/yr mercury reduction in Central Valley mercury outflows, will not be possible without substantial reductions in nonpoint sources in the tributary watersheds. Methylmercury loading from the Sacramento River, Yolo Bypass, San Joaquin River and Mokelumne River watershed inputs (tributaries that contribute both high methylmercury concentrations and loads to the Delta) need to be reduced to achieve the implementation goal for methylmercury in ambient water in the Mokelumne/Cosumnes, Sacramento, San Joaquin, and Yolo Bypass subareas of the Delta.

As noted earlier, the San Francisco Bay Water Board is considering a Basin Plan amendment to control mercury in the Bay. The control plan focuses on the reduction of the mercury content of Bay sediment to 0.2 mg/kg. The control plan assigns the Central Valley a mercury load reduction of 110 kg per year (Johnson and Looker, 2004). Half of the reduction is to be achieved within 10 years of approval of the Central Valley Regional Water Quality Control Board's Phase I mercury Basin Plan Amendment for the Delta and the remainder within 20 years. To achieve the reduction, control efforts in the Delta source region should focus on the Cache Creek, Feather River, American River and Putah Creek watersheds because these watersheds export the largest volume of highly contaminated sediment (see Tables 7.5 and 7.17 in the TMDL Report). Staff recommends that total mercury loading from the Cache Creek Settling Basin be reduced by **72 kg/yr** and that the sum of nonpoint sources of total mercury from the American River, Putah Creek and Feather River be reduced by **38 kg/yr**. Staff recommends that the proposed reductions for these Sacramento Basin tributaries be based on average annual loads estimated for the WY1984-2003 period. This 20-year period includes a mix of wet and dry years that is statistically similar to what has occurred in the Sacramento Basin over the last 100 years.

The Cache Creek Settling Basin is a 3,600-acre structure located at the base of the Cache Creek watershed.[22] The U.S. Army Corp of Engineers initially constructed the Settling Basin in 1937 to contain sediment and maintain the flood capacity of the Yolo Bypass. The Basin was modified in 1993 to increase its sediment trapping efficiency. However, no provision was made for removing the additional trapped material. Most of the mercury in Cache Creek is transported on sediment. Therefore, an increase in sediment trapping also results in deposition and retention of mercury. The Settling Basin currently traps about 50% of the sediment and mercury transported by Cache Creek (Foe and Croyle, 1998; CDM, 2004; Cooke *et al.*, 2004). The rest is exported to the Delta through the Yolo Bypass. On average, the Settling Basin receives about 250 kg/yr from the Cache Creek watershed and discharges about 125 kg/yr to the Yolo Bypass. The sediment/mercury trapping efficiency of the Settling Basin is expected to decrease as the Settling Basin fills and may reach zero in about 40 years unless a maintenance program is instituted to periodically remove material (CDM, 2004). A non-operational Settling Basin would result in a mercury discharge to the Yolo Bypass and Delta of about 250 kg/yr, an addition of 125 kg/yr mercury loading (see Table 7.6b in the TMDL Report).

Staff recommends that total mercury loading from the Cache Creek Settling Basin be reduced by 72 kg/yr, resulting in an acceptable load to the Yolo Bypass and Delta of 53 kg/yr. This reduction is approximately 65% of the 110-kg/yr reduction required by the San Francisco Bay mercury TMDL. Two sets of actions are considered for the Cache Creek Settling Basin to ensure that mercury loads to the Delta decrease. First, mercury loads entering the Settling Basin from the Cache Creek watershed need to be reduced. The Basin Plan Amendment for control of mercury in Cache Creek was adopted by the Central Valley Water Board in October 2005. Implementation actions included in the Basin Plan Amendment would reduce mercury loads entering the Cache Creek Settling Basin by about 60 kg/year (Cooke and Morris, 2005). Approximately 25 kg per year may come from instituting control programs at all major mercury mines in the watershed.[23] The remainder of the reduction will be achieved by control of erosion in mercury-enriched areas and by remediation/stabilization of contaminated floodplain sediment in the Cache Creek canyon and in Bear Creek. However, most the total mercury load now leaving the

[22] The Settling Basin is owned by local private landowners and the California Department of Water Resources.

[23] The mines are located in Harley Gulch, Sulfur and Bear Creeks and Clear Lake.

watershed appears to originate from erosion of mercury contaminated sediment in the active flood plain downstream of the mines. Studies are described in the Cache Creek Basin Plan Amendment to evaluate in-stream sediment control options. However, it is unclear whether environmentally acceptable, cost effective control programs can be developed to significantly curtail the movement of this material.

As result, a second set of actions should focus on decreasing the mercury load leaving the Settling Basin. A program should be instituted to (a) periodically excavate the material presently accumulating in the basin, and (b) make additional modifications to the Settling Basin to increase trapping efficiency. Initial modeling results indicate that Basin operation and design could be modified to remove up to an additional 55 kg/yr (CDM, 2004, Table 4-3, Alternative 5 - Excavate and Raise Weir Early), improving the trapping efficiency of the Settling Basin from 50% to 72%. Additional studies are underway to evaluate improvement options and costs.

As noted above, implementation actions resulting from the Cache Creek mercury control program would reduce average annual mercury loads entering the Settling Basin by about 60 kg/yr, from 250 to 190 kg/yr. Because of the current 50% trapping efficiency of the Settling Basin, discharges leaving the Settling Basin would be reduced by 30 kg/yr, from 125 kg/yr to 95 kg/yr. If the Settling Basin trapping efficiency were improved from 50% to 72%, and Settling Basin inputs were reduced from 250 kg/yr to 190 kg/yr, then Settling Basin mercury discharges would decrease from the current 125 kg/yr to a future 53 kg/yr, for a total reduction of 72 kg/yr from the Settling Basin.

Staff recommends that the sum of nonpoint sources of total mercury from the American River, Putah Creek and Feather River be reduced by 38 kg/yr. As described in earlier sections, staff recommends that point sources (e.g., NPDES permitted facility and MS4 discharges) be capped at existing total mercury loading rates. Specific reductions for the Feather River, American River and Putah Creek watersheds nonpoint sources are not defined in Table 8.4 in the TMDL Report to allow for greater flexibility in developing future reduction strategies. However, the sum of the load reductions for these watersheds and Cache Creek Settling Basin must equal or exceed 110 kg/yr. Staff will focus future TMDL efforts on these watersheds. Monitoring is underway to identify sources of methyl and total mercury in these and other tributary watersheds.

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Action Box #6: Existing Native & Managed Wetlands

Geographic Scope: Native and managed wetlands and duck clubs in the Delta and within 30 miles upstream of the Delta.

Responsible Parties: USFWS, CalFed, CDFG, municipal and non-profit agencies and private landowners, Natural Resources Conservation Service, local conservation districts, and restoration project proponents.

Source Control Strategy:

- MeHg allocations for each subarea apply to the sum of existing discharges from wetlands. Allocations are based on the estimated sediment flux of MeHg from wetlands in each Delta subarea and the amount of MeHg source load reduction needed for Delta waters to achieve the proposed implementation goal of 0.06 ng/l in each subarea.
- Responsible parties are required – either individually or collaboratively – to complete MeHg characterization and control studies and to develop a management plan that describes practices that can be implemented to achieve the subarea-based MeHg allocations for wetlands, a time schedule for implementation and, if applicable, detailed information documenting why fully achieving the MeHg allocations is infeasible.
- Parties responsible for new sources of MeHg from wetlands proposed to be initiated between the effective date of this amendment and 2014 (when the Central Valley Water Board considers TMDL revisions and control measures based on the results of characterization and control studies) are prohibited unless the discharge MeHg concentration is less than the source water MeHg concentration or the responsible parties participate in the studies discussed above and increases in MeHg are approved by the Executive Officer. New discharges that begin after the effective date of this amendment may necessitate adjustments to the MeHg allocations.
- Parties responsible for existing and new sources of MeHg from wetlands implement MeHg management practices after 2014 based on the results of the control studies and Central Valley Water Board approval of proposed management plans.

Actions Required & Timeline:

- 2007: Central Valley Water Board requires responsible parties for existing Delta wetlands and proposed wetland restoration efforts expected to be initiated before 2014 to submit study plans for (a) the development of MeHg management practices to reduce MeHg discharges from wetlands and (b) the evaluation of mitigation options by 31 December 2007. Study plans may be coordinated through Delta subarea groups, watershed groups or other collaborative or individual efforts.
- 2007 to 2012: Responsible parties conduct studies and submit interim progress reports by 31 December 2009 and final reports by 31 December 2012.
- 2013: Central Valley Water Board staff updates TMDL MeHg source analysis and implementation strategies and drafts a new proposed Basin Plan amendment with revised MeHg allocations based on the results of the characterization and control studies.
- 2014: Central Valley Water Board reviews cost and efficacy of MeHg characterization and control studies and determines whether to require their implementation. If on-site MeHg control methods are not technically or economically feasible, Board members evaluate other mitigation options proposed by the project proponent, possibly including an offset program. Board members consider amending allocations in Basin Plan to reflect improved MeHg load estimates and control measures.
- December 2014: The discharge of MeHg into the Delta or its tributaries within 30 miles upstream of the legal Delta boundary is conditionally prohibited after 31 December 2014 (see Action Box #1).
- 2015 onward: Existing and new wetland projects implement MeHg control measures as required.

Action Box #7: Flood Conveyance

Geographic Scope: Yolo Bypass.

Responsible Parties: USACE, State Reclamation Board, DWR, Sacramento Area Flood Control Agency, local reclamation, levee and drainage districts and municipalities.

Source Control Strategy:

- Cap MeHg and TotHg concentration and loading caused by flood flows from Yolo Bypass at existing levels.
- Parties responsible for existing and proposed flood conveyance projects are required to coordinate with wetland and agricultural landowners to characterize existing MeHg discharges to open waters from lands immersed by managed flood flows and to develop control measures by 2012 (see Action Box #1).
- Parties responsible for existing and proposed flood conveyance projects are required to implement feasible MeHg and TotHg control measures based on results of the characterization and control studies and Central Valley Water Board approval of proposed management plans. Responsible agencies may participate in a mercury offset program (see Action Box #2).

Actions Required & Timeline:

- 2007: Central Valley Water Board requires responsible agencies to submit collaborative study plans by 31 December 2007 to characterize effects of flood flows on MeHg concentrations and loads discharged from existing wetlands and riparian areas in Yolo Bypass (see also Action Box #6).
- 2007 onward: During the CEQA review process, agencies responsible for implementing changes to flood conveyances evaluate effects of the project alternatives on MeHg and TotHg loading; if an alternative would increase mercury loading, mitigation would be required.
- 2008 to 2012: Responsible agencies conduct studies to characterize baseline conditions. If studies indicate that flood flows increase MeHg concentrations of wetland/riparian discharges to the Delta, agencies conduct additional studies to evaluate mitigation options. Responsible parties submit interim progress reports by 31 December 2009 and final reports by 31 December 2012.
- 2013: Central Valley Water Board staff updates TMDL MeHg source analysis and implementation strategies and drafts a new proposed Basin Plan amendment with revised MeHg allocations based on the results of the characterization and control studies.
- 2014: Central Valley Water Board reviews cost and efficacy of MeHg characterization and control studies and determines whether to require their implementation. If on-site MeHg control methods are not technically or economically feasible, Board members evaluate other proposed mitigation options, possibly including an offset program. Board members consider amending allocations in Basin Plan to reflect required control measures.
- 2015 onward: Responsible agencies implement any feasible mitigation measures.

Action Box #8: Delta Island / Agricultural Return Flows

Geographic Scope: Agricultural areas within the Delta and its 30 mile radius.

Responsible Parties: Reclamation districts and landowners.

Source Control Strategy:

- MeHg allocations for each subarea apply to the sum of existing discharges from wetlands. Allocations are based on the estimated MeHg loading from Delta Islands in each Delta subarea and the amount of MeHg source load reduction needed for Delta waters to achieve the proposed implementation goal of 0.06 ng/l in each subarea.
- Responsible parties are required – either individually or collaboratively – to complete MeHg characterization and control studies and to develop a management plan that describes practices that can be implemented to achieve the MeHg allocations in each Delta subarea, a time schedule for implementation and, if applicable, detailed information documenting why fully achieving the MeHg allocations is infeasible.
- Parties responsible for new sources of MeHg from new or expanded agricultural uses (or new changes to crops or irrigation practices) initiated between the effective date of this amendment and 2014 (when the Central Valley Water Board considers TMDL revisions and control measures based on the results of characterization and control studies) are prohibited unless the agricultural return water MeHg concentration is less than the source water MeHg concentration or the responsible parties participate in the studies discussed above and increases in MeHg are approved by the Executive Officer. New MeHg discharges that begin after the effective date of this amendment may necessitate adjustments to the allocations.
- Parties responsible for existing and new sources of MeHg from agricultural lands implement MeHg management practices after 2014 based on the results of the control studies and Central Valley Water Board approval of proposed management plans.

Actions Required & Timeline:

- 2005 to 2007: Moss Landing Marine Laboratories conducts study to characterize MeHg concentrations and loads in agricultural source waters and runoff from Delta Islands.
- 2007: Central Valley Water Board staff re-evaluates agricultural MeHg load estimates and allocations developed in 2005. If agricultural lands in the Delta act as a net source of MeHg to the Delta, then Delta reclamation districts and landowners in, and within 30 miles upstream of, the Delta conduct collaborative studies to develop management practices to reduce MeHg loads.
- 2008 to 2012: Reclamation districts and landowners conduct MeHg control studies as required.
- 2013: Central Valley Water Board staff updates TMDL MeHg source analysis and implementation strategies and drafts a new proposed Basin Plan amendment with revised MeHg allocations based on the results of the characterization and control studies.
- 2014: Central Valley Water Board reviews cost and efficacy of MeHg control studies and determines whether to require their implementation. If on-site control methods are not technically or economically feasible, the Board evaluates other mitigation options to achieve the WQO, possibly including an offset program. Central Valley Water Board considers amendment of Basin Plan to reflect improved load estimates and required control measures.
- December 2014: The discharge of MeHg into the Delta or its tributaries within 30 miles upstream of the legal Delta boundary is conditionally prohibited after 31 December 2014 (see Action Box #1).
- 2015 onward: Landowners and reclamation districts implement MeHg control measures as required.

Action Box #9: Water Management

Geographic Scope: Open-water channels within the Delta and its tributary watersheds downstream of major dams.

Responsible Parties: USBR, DWR, State Water Board, USACE and private entities.

Source Control Strategy:

- Cap MeHg and TotHg concentration and loading caused by existing water management practices in the Delta source region.
- Parties responsible for water supply management in the Delta region are required to conduct collaborative studies to characterize baseline MeHg production in open channels during different flow conditions in the Delta and to identify feasible control measures, in particular:
- Evaluate direct and indirect effects of flow management practices on sulfate concentrations and MeHg production in the Delta; and
- Conduct sulfate amendment studies to determine whether sulfate concentrations affect MeHg production rates and resulting ambient water column concentrations in the Delta.
- Reduce MeHg production in open channels using feasible control measures identified by the above studies. Allow no net increase in MeHg concentrations in Delta waters as a result of (a) future changes to water delivery to, diversions from, or storage in the Delta or within 30 miles of the Delta, or (b) future changes to salinity standards or flow management practices used to maintain current salinity standards. The State Water Board is requested to evaluate direct and indirect effects of changes in salinity standards on MeHg production. If changes to the salinity standards (or changes to flow management practices used to maintain current salinity standards) would increase MeHg levels, then the State Water Board should require responsible agencies to conduct studies and develop management plans to reduce MeHg concentrations. As necessary, management plans should be developed prior to changes in salinity standards or other water management practices.
- Inter-agency agreements and coordination with SWRCB authority over water rights will be needed to ensure that existing and potential impacts are properly characterized and feasible MeHg controls implemented.

Actions Required & Timeline:

- 2007: Central Valley Water Board requires responsible agencies to submit by 31 December 2007 collaborative study plans to characterize baseline MeHg production in open channels in the Delta and to evaluate feasible control measures.
- 2007 onward: During the CEQA review process, agencies responsible for implementing changes to water management practices evaluate effects of the project alternatives on MeHg and TotHg loading. If an alternative would increase ambient MeHg concentrations in the Delta or increase TotHg loading to the Delta, mitigation would be required.
- 2008 to 2012: Responsible agencies conduct studies and submit interim progress reports by 31 December 2009 and final reports by 31 December 2012.
- 2013: Central Valley Water Board staff updates TMDL MeHg source analysis and MeHg allocations based on the results of the characterization and control studies.
- 2014: Central Valley Water Board reviews results of characterization and control studies and considers an amendment to the Basin Plan to reflect updated MeHg allocations and feasible control measures.
- 2015 onward: Responsible agencies implement any feasible MeHg control measures, as directed by the Central Valley Water Board.

Action Box #10: Local & Statewide Air Emissions

Geographic Scope: Atmospheric deposition within the Delta and tributary watersheds downstream of major dams resulting from local and statewide emissions.

Oversight Agencies: USEPA, State Water Board and Air Resources Board

Source Control Strategy:

- Cap total mercury loads produced by air emission sources in and upwind of the Delta and its tributary watersheds.
- Develop an inter-agency agreement between USEPA, the State Water Board, and the Air Resources Board to:
  - Evaluate local and statewide air emission sources and depositional patterns;
  - Evaluate dry and wet deposition in the Delta and its tributary watersheds; and
  - If studies indicate that atmospheric loading from local or statewide sources is substantial, develop management practices and implement load reductions.

Recommended Actions & Timeline:

- 2005 to 2006: Texas A&M University researchers conduct study to measure total mercury in atmospheric deposition at sites in the Sierra Nevada Mountain Range, Coastal Range, and Delta.
- 2007 to 2013: State Water Board develops agency agreement with the USEPA and Air Resources Board to conduct studies to evaluate local and statewide air emissions and deposition patterns and to develop and implement a load reduction program(s).
- 2013: Central Valley Water Board staff updates TMDL source analysis and drafts a new Basin Plan amendment based on characterization and control study results.
- 2014: Central Valley Water Board reviews results of characterization and control studies and considers an amendment to the Basin Plan to incorporate feasible control measures.
- 2015 onward: Responsible agencies implement necessary air emission controls, as directed by the Central Valley Water Board.

Action Box #11: Cache Creek Watershed & Settling Basin

Geographic Scope: Cache Creek watershed and Cache Creek Settling Basin.

Responsible Parties: DWR and USACE (Settling Basin), and responsible parties identified by the Cache Creek watershed mercury TMDLs.

Source Control Strategy:

- As a result of the Cache Creek watershed mercury control program, reduce long-term Cache Creek watershed TotHg loading to Cache Creek Settling Basin by 60 kg/yr (from 250 kg/yr to 190 kg/yr), which would result in a reduction of ~30 kg/yr from Cache Creek Settling Basin exports to the Yolo Bypass (from ~125 kg/yr to 95 kg/yr), assuming the Basin trapping efficiency remained at 50%.
- Improve efficiency of Cache Creek Settling Basin from 50% to 72% to trap an additional 55 kg/yr of TotHg assuming current inputs to the Basin of 250 kg/yr, or an additional 42 kg/yr of TotHg after Cache Creek watershed mercury controls have been implemented. Future mercury control programs for the Yolo Bypass may require additional mercury removal from the Basin.
- Load reductions from the Basin may be accomplished through a mercury offset program.
- Decrease MeHg loading from Cache Creek Settling Basin to the Yolo Bypass by the amount needed to achieve the implementation goal for MeHg in ambient water in the Yolo Bypass subarea of the Delta.

Actions Required & Timeline:

- Fall 2005 onward: Responsible parties implement the Cache Creek watershed TMDLs' implementation activities, per Basin Plan Amendment approved by the Regional Board in October 2005, to reduce TotHg exported by the Cache Creek Settling Basin by 30 kg/yr.
- 2007: By 31 December 2007 responsible agencies submit a plan for (a) removing contaminated sediments and improving the trapping efficiency of the Settling Basin to reduce its TotHg discharge by an additional 42 kg/yr, and (b) evaluating options to control MeHg production in the Settling Basin.
- 2010: By 31 December 2010, responsible agencies commence control actions to reduce total mercury loads from the Settling Basin, or coordinate with proponents of total mercury offset projects if they select the Settling Basin as a project. Additional total mercury control actions for the Settling Basin may be required in the future to address mercury impairment in the Yolo Bypass.
- 2012: By 31 December 2012 responsible agencies complete MeHg control studies and identify management practices to reduce MeHg production in the Settling Basin to achieve the MeHg allocation for exports to Yolo Bypass.
- December 2014 onward: By 31 December 2014 responsible agencies begin control actions to reduce methylmercury loads from the Settling Basin as directed by the Central Valley Water Board.

Action Box #12: Other Tributary Watersheds

Geographic Scope: Tributary watersheds downstream of major dams.

Oversight Agency: Central Valley Water Board.

Source Control Strategy:

- Decrease MeHg loading from the Sacramento River, Yolo Bypass, San Joaquin River, French Camp Slough, Mokelumne River, Morrison Creek, Ulatis Creek and Marsh Creek watershed inputs by the amount needed to achieve the implementation goal for MeHg in ambient water in the Mokelumne/Cosumnes, Sacramento, San Joaquin, Yolo Bypass and Marsh Creek subareas of the Delta.
- Cap MeHg inputs from Calaveras River, Bear/Mosher Creeks, and other small drainages.
- Reduce by 38 kg/yr the sum of TotHg nonpoint source loads from the American River, Putah Creek and Feather River to the Delta. Cap point sources downstream of major dams at current TotHg loads.
- Cap all point and nonpoint TotHg sources in other tributaries.

Actions Required & Timeline:

- 2006 to 2020: Central Valley Water Board staff develops MeHg load allocations and reduction programs for nonpoint sources in the 303(d) listed lower American River, lower Sacramento River, Feather River, Marsh Creek, Putah Creek, and San Joaquin River watersheds, to be included in future Basin Plan amendments. In addition, staff identifies MeHg sources and develops control programs for the Mokelumne River, Yolo Bypass and tributaries to the Yolo Bypass not currently on the 303(d) List. The reductions required to achieve the Delta WQO would be used as minimum reductions; additional reductions may be required to achieve future tributary-specific WQOs for 303(d)-Listed tributaries.
- 2013: Central Valley Water Board staff updates Delta MeHg TMDL source analysis and drafts a new Basin Plan amendment.
- 2014: Central Valley Water Board reviews results of characterization and control studies and considers an amendment to the Basin Plan to incorporate feasible control measures.
- 2014 to 2020: Regional Board staff identifies MeHg sources and quantifies allocations for the tributaries to the Delta not currently on the 303(d) List that require MeHg load reductions (French Camp Slough, Ulatis Creek, and Morrison Creek).

4.3.5 Actions Addressing New Sources of Methylmercury

The Delta methylmercury TMDL is based on source information available in 2004 and 2005. The Delta mercury control program must ensure that there is no net increase in methylmercury concentrations in Delta waters resulting from cumulative inputs from new or expanded projects, or changes to existing projects. New methylmercury sources could include, but are not limited to, restoration of wetlands, construction of new or enlarged reservoirs,[24] runoff from new urban developments and other land use changes, changes in water and levee management practices,[25] and new, expanded or modified WWTPs. Projects in the Delta or within 30 miles upstream of the Delta implemented after 2014[26] with discharge methylmercury concentrations greater than the implementation goal of 0.06 ng/l would be required to mitigate that portion of their loading that increases their discharge concentrations above the implementation goal. Projects that do not have a discharge *per se* (e.g., flood conveyance and other water management activities) but that could result in increased methylmercury production in the Delta would be required to evaluate and mitigate any such increase. Action boxes #1 through 10 identify source-specific requirements for new sources of methylmercury.

Proposed projects that could result in increased methylmercury concentrations in Delta waters should be accompanied by a CEQA and/or NEPA analysis that evaluates and mitigates its entire impact on the mercury impairment in the Delta. Staff will monitor the preparation of CEQA/NEPA environmental impact statements/reports for projects in the Delta and its tributary watersheds that have the potential to impact methylmercury impairment in the Delta. The analyses of the potential project impacts will be reviewed for completeness and technical adequacy and comments will be provided to the project lead agency.

Depending on the type of project, other State and federal regulations may also require that the full potential impact of such a project on methylmercury be mitigated. The Central Valley Water Board will either exercise its authority to implement these regulations (e.g., through NPDES permits and CWA Section 401 water quality certifications) or coordinate with the agencies with appropriate jurisdiction to ensure that potential impacts on methylmercury conditions in the Delta are properly addressed. Additionally, the Central Valley Water Board will recommend to the State Water Board that approval of such projects under their water rights or other authorities be contingent upon the effects of the project being properly evaluated and mitigated. The Central Valley Water Board will provide input on the potential water quality impacts of such projects during State Water Board preparation or modification of the water right permits or other approvals.

[24] New water impoundments have been found to stimulate sediment microbial activity and to increase methylmercury concentrations (Chapter 3 in TMDL Report). The Record of Decision for the Bay-Delta Authority directs it to evaluate several surface water storage options for improving water management. The projects may require a 401 water quality certification from the Regional Board.

[25] Such as the South Delta Improvement Project described earlier.

[26] The Central Valley Water Board will consider Delta methylmercury TMDL revisions and control measures based on the results of characterization and control studies proposed in this report in 2014.

4.3.6 Public Outreach and Education

As described in Section 4.2.2, reduction of public exposure to mercury in local fish is a necessary component of all mercury control strategies evaluated in the alternatives analysis. Action Box #13 identifies the actions and time schedules recommended for the public outreach and education component of the Delta mercury implementation plan.

The proposed implementation plan contains two elements intended to reduce public exposure to mercury in local fish:

1. The Central Valley Water Board recommends that the Office of Environmental Health Hazard Assessment (OEHHA) evaluate new fish contamination information collected in the Delta and determine whether the present fish advisory for striped bass should be extended to other game fish and shellfish. With funding from the California Bay-Delta Authority, the San Francisco Estuary Institute is coordinating sampling of fish in the Delta and tributaries in 2005 and 2006 (SFEI, 2005). OEHHA anticipates releasing draft advisories for game fish other than striped bass and sturgeon in 2007.

2. Local county health departments, CDHS, and dischargers should coordinate efforts to expand existing programs for outreach and education regarding the risks of consuming fish containing mercury, emphasizing portions of the population that are at risk, such as pregnant women and children. The goal of the expanded education and outreach program would be to attempt to instruct people about the sizes and species of fish that may be harmful to consume while emphasizing that other less contaminated varieties are an excellent source of protein. The public outreach program should include materials in multiple languages and media. It should also include examination of effectiveness of the outreach.

County health departments may have the ultimate responsibility for conducting public outreach and education. However, CDHS may provide assistance in conducting public outreach based on its completion of pilot angler and consumer surveys of fish consumption, outreach efforts with representatives of some high-consuming groups in the Delta, and development of educational materials in multiple languages (CDHS, 2004; 2005). The Central Valley Water Board staff is working toward developing an outreach and education strategy that may be used to guide outreach efforts.

A monitoring plan will be added to Chapter 5 (Surveillance and Monitoring) of the Basin Plan. Staff proposes that largemouth bass be sampled regularly until mercury concentrations approach the proposed implementation goal for largemouth bass, when sampling would be broadened to include other species to evaluate compliance with the proposed water quality objectives for large TL3 and TL4 fish and small TL2/TL3 fish. Concentrations of mercury in largemouth bass are correlated with concentrations in other species. To reduce the costs of monitoring, concentrations in largemouth bass can be used to predict concentrations in other species. Staff will report monitoring results to the Central Valley Water Board and to the public.

As in other water bodies in the Central Valley and other basins in California, water quality objectives are proposed for mercury in Delta fish. Through the Surface Water Ambient Monitoring Program (SWAMP) and other programs, the State Water Boards should ensure that monitoring occurs. Monitoring is needed for public outreach because the data determine the message that is conveyed, regarding which fish species should be avoided and which can safely be eaten. Frequency of monitoring mercury in fish should be

coordinated with other SWAMP fish collection and with the needs of OEHHA and CDHS to maintain consumption advice appropriate to the fish tissue concentrations. To meet the needs of the implementation plan, Central Valley Water Board staff recommends that largemouth bass monitoring occur every ten years. At least every 25 years, monitoring should include other TL2, TL3 and TL4 species to verify that the correlations between largemouth bass and other species remain valid.

Action Box #13: Public Outreach & Education

Geographic Scope: Within the Delta.

Agencies: Central Valley Water Board, State Water Board, CDHS, OEHHA, Delta county health departments

Source Control Strategy:

- Reduce public exposure to MeHg in Delta fish by coordinating with State and county agencies to:
  - Extend the Delta fish advisory as needed;
  - Expand existing education and outreach programs; and
  - Conduct periodic fish sampling to assess changes in fish mercury levels over time.

Recommended Actions & Timeline:

- 2005-2007: The San Francisco Estuary Institute (SFEI) and CDHS conducts a study funded by CalFed in the Delta and major tributaries to quantify fish MeHg concentrations and patterns of fish consumption.
- 2006 onward: CDHS and County health departments conduct public outreach and education, including characterization of groups with high rates of fish and shellfish consumption, designing and dissemination of educational material in appropriate languages and media, and monitoring of effectiveness of educational efforts.
- 2007: OEHHA anticipates issuing revised fish consumption advisories for the Delta that cover multiple species of fish consumed.
- 2011: In 2011 and regularly thereafter, the Central Valley and State Water Boards evaluates fish MeHg concentrations to track progress in meeting water quality objectives and to provide fish concentration data to guide public outreach.
- 2013: Central Valley Water Board staff updates Delta MeHg TMDL source analysis and drafts a new Basin Plan amendment. The extent of mercury impairment in the Delta would be updated using fish mercury data collected by SFEI and CDHS in 2005-2007.
- 2014: Central Valley Water Board reviews results of recent fish sampling efforts and characterization and control studies and considers an amendment to the Basin Plan to incorporate feasible control measures.

5 MONITORING

Chapter 5 of the Basin Plan describes the methods and programs that the Central Valley Water Board uses to acquire water quality information. Acquisition of data is a basic need of a water quality control program and is required by the Clean Water Act and the Porter-Cologne Water Quality Control Act.

A monitoring plan is also an essential element of the methylmercury control strategy for the Delta. The goal of monitoring is to measure whether ambient methylmercury concentrations have been reduced and to track progress in achieving the water quality objectives. Monitoring in the Delta and its tributaries will include fish tissue, water and sediment sampling. For methylmercury control studies conducted in Phase 1 of the implementation plan, Central Valley Water Board staff will review monitoring plans.

Central Valley Water Board staff will take the lead in determining compliance with the fish tissue objectives. Monitoring for compliance with the proposed methylmercury allocations from specific sources shall be conducted by responsible parties for the source. Fish tissue sampling required to evaluate the impact of a particular project (see Section 5.1) will be the responsibility of the project proponent.

The proposed modifications to Basin Plan Chapter 5 (Surveillance and Monitoring) are presented after the Executive Summary at the beginning of this report. This chapter provides an explanation of the monitoring program. Section 5.1 contains guidance for fish tissue monitoring in the Delta. Section 5.2 contains guidance for water monitoring in the Delta and in tributaries within 30 miles of the Delta. Section 5.3 provides guidance for sediment monitoring during dredging and methylmercury control studies.

5.1 Fish Tissue Monitoring

For all fish tissue monitoring discussed below, analysis for total mercury is an appropriate and economical option rather than analysis for methylmercury. Methylmercury comprises 85 to 100% of the total mercury measured in fish (Becker and Bigham, 1995; Slotton *et al.*, 2004). Total mercury may be analyzed and reported without adjustment instead of methylmercury in fish samples in order to reduce analytical costs.

5.1.1 Compliance with Large TL3 & 4 Fish Objectives

Two water quality objectives for the Delta are in the form of methylmercury in muscle tissue of large, trophic level three and four fish. The primary TL3 species in the Delta caught by humans or wildlife are black bullhead, bluegill, carp, Chinook salmon, redear sunfish, Sacramento blackfish, Sacramento sucker, and white sturgeon. The primary TL4 species are largemouth and striped bass, channel and white catfish, crappie, and Sacramento pikeminnow. To show compliance in each Delta subarea, the average mercury concentration in samples of TL3 and TL4 fish of at least three species per trophic level must equal the TL3 and TL4 objectives. The Delta TL3 and TL4 fish objectives were developed assuming that humans and large, piscivorous wildlife species (e.g., bald eagle, osprey, and river otter) would likely consume fish in the size range of 150-500 mm total length.

For purposes of monitoring, it is helpful to lessen the range of fish and sizes to be tested, provided that an appropriate indicator species is available. Largemouth bass in the Delta and elsewhere have been shown

to be good bioindicators of methylmercury contamination (Davis *et al.*, 2003). Largemouth bass are widely available and non-migratory, and show good length versus mercury concentration relationships. In addition, concentrations of mercury in largemouth bass show statistically significant, positive correlations with mercury in other fish in the Delta (See Section 4.7 of the TMDL Report). Sampling only largemouth bass only is an economical way to track improvements in the Delta.

As described in Chapter 5 of the TMDL Report, only largemouth bass were collected concurrently with aqueous methylmercury data. Staff used the statistically significant relationship between mercury concentrations in largemouth bass and methylmercury concentrations in water to link fish to water and to determine the necessary reductions in methylmercury loads. Staff developed a mercury implementation goal in largemouth bass at a standard length of 350 mm of 0.24 mg/kg, wet weight. This largemouth bass concentration corresponds to the TL3 objective of 0.08 mg/kg (see Section 4.7.4 and Table 4.8 of the TMDL Report). The largemouth bass implementation goal is expected to protect humans and wildlife species that eat fish from a mixture of trophic levels. As described in the TMDL Report, the largemouth bass level that corresponds to the objective in large TL3 fish is the most conservative of all of the largemouth bass concentrations that correspond to safe levels in small and large TL2, TL3, and TL4 fish.

Two tiers of fish monitoring should be conducted for compliance with the objective.

- Evaluate progress toward largemouth bass implementation goal; and
- Test compliance with water quality objectives in large fish.

Tier 1: Evaluate progress toward largemouth bass implementation goal. At regular intervals after the start of implementation activities (suggested interval: every five years), concentrations of mercury in largemouth bass should be evaluated. Samples should be collected in each subarea for comparison with existing concentrations in largemouth bass at a standard, total length of 350 mm. When concentrations in largemouth bass approach 0.24 mg/kg, sampling should be broadened to Tier 2.

Largemouth bass in a range of sizes bracketing 350 mm should be sampled in order to develop a relationship between size and mercury concentration, from which the concentration in a 350 mm fish can be estimated. The variance in mercury concentrations will determine how many fish samples are needed in order to develop a statistically significant, mathematical relationship between size and tissue concentration. However, in previous sampling in the Delta, 10 samples collected in a single sampling event and site were sufficient to produce a statistically significant relationship (Davis *et al.*, 2003). Fish should be analyzed individually to develop the regression.

Tier 2: Test compliance with water quality objectives in large fish. After the largemouth bass implementation goal is reached, sampling should include other TL3 and 4 species to test full compliance with the water quality objectives. The following conditions are proposed to determine compliance with the proposed Delta water quality objective:

- The TL3 fish species proposed for compliance monitoring are: black bullhead, bluegill, carp, Chinook salmon, redear sunfish, Sacramento blackfish, Sacramento sucker, and white sturgeon.
- The TL4 fish species proposed for compliance monitoring are: Sacramento pikeminnow, largemouth and striped bass, channel and white catfish, and white and black crappie.
- Within each subarea, fish from at least three species within each trophic level should be collected.
- Sample size for determining compliance should be determined using statistical methods approved by the Executive Officer of the Central Valley Water Board. The USEPA has published fish

sampling guidance (1995b). Staff proposes that the average concentrations should be calculated from at least ten samples from individual fish or composites.

- The average concentrations in TL4 and TL3 fish are equivalent to the corresponding fish tissue objectives each year for three consecutive years.

5.1.2 Compliance with Small TL2/3 Fish Objective

Two of the water quality objective alternatives contain an objective for methylmercury in small, TL2/3 fish. The least tern, which is federally listed as endangered, feeds on fish less than 50 mm in total length. If the Central Valley Water Board adopts a small fish objective for the Delta, small fish should be sampled when large TL3 and TL4 fish are sampled for comparison with the fish tissue objective to verify that wildlife species that depend on small Delta fish are protected. Fish species appropriate for sampling to ensure that least tern and other wildlife feeding on small (<50 mm) fish are: juvenile bluegill, inland silverside, mosquitofish, red shiner and threadfin shad.

5.1.3 Data Gathering for Public Outreach

The implementation plan calls for reducing the exposure of people who eat fish to methylmercury by increasing public outreach and education. In order to craft a useful message of which fish species to avoid and which are safe to eat, health advisors need to know the concentrations of mercury in fish typically consumed. The State and Regional Water Boards should take the lead in ensuring that fish tissue data are collected, either by the Water Boards or others, so that information can be provided to fish consumers.

In the Delta, providing fish tissue data to guide public outreach may require more sampling than the periodic largemouth bass sampling described above. The Delta TMDL Report describes statistically significant relationships between mercury concentrations in largemouth bass and other species commonly consumed. These relationships suggest that declines in concentrations in largemouth bass will be matched by declines in other species of fish and shellfish. After several rounds of largemouth bass sampling (i.e., 20 years after start of implementation), it may be necessary to sample other fish species to verify that the relationships are valid and provide updated information on health risks to consumers.

It may also be necessary to monitor species that are frequently consumed but have little monitoring data. In particular, few samples are available for Chinook salmon and American shad. It is useful to note that these fish species have low mercury levels (averages 0.05 and 0.07 mg/kg wet weight, respectively; see Appendix C of the TMDL Report).

Staff recommends that OEHHA be consulted during planning for fish sampling. In order to modify or remove the fish tissue advisory currently in place for the Delta, OEHHA may require that mercury levels be evaluated in species popular for sport or commercial fishing.

5.1.4 Source or Project Assessment

Fish tissue sampling can help to evaluate the impact of a particular source or project (e.g., testing a methylmercury control program in a wetland). For this purpose, monitoring of young fish that remain in a relatively defined home territory is recommended. Young fish will more quickly reflect changes in

mercury bioavailability than will larger or older fish, which integrate mercury uptake over years and large spatial areas. Inland silversides are recommended for monitoring because they are widespread in the Delta, maintain relatively localized home ranges, and have very consistent same-site, individual, whole body mercury concentrations at sizes of about 45 to 75 mm (Slotton *et al*., 2002). Other species listed in Section 5.1.2 may also be appropriate for monitoring, depending on local abundance. Baseline levels of methylmercury in these species are fairly well established in the Delta (Slotton *et al*., 2002).

5.2 Water Monitoring

5.2.1 Methylmercury

The Central Valley Water Board and responsible parties in the Delta or tributaries will need to monitor methylmercury in water to satisfy requirements of the implementation plan. The plan sets an implementation goal for average annual methylmercury in ambient water of 0.06 ng/l. Responsible parties that are assigned methylmercury allocations based on this concentration must monitor methylmercury in their discharge and will be required to report results to the Central Valley Water Board. Methylmercury control studies will likely necessitate that dischargers and other responsible parties monitor methylmercury in discharge and ambient water.

As resources are available, the Central Valley Water Board staff may periodically monitor methylmercury in ambient water in the Delta to track progress in meeting the implementation goal for ambient water. Central Valley Water Board staff will continue monitoring methylmercury in Delta tributaries as part of developing TMDLs for those tributaries and implementing the Delta TMDL.

5.2.2 Total Mercury

An objective of the implementation plan is to meet the total mercury allocation assigned to the Delta in the San Francisco Bay Mercury TMDL (Johnson & Looker, 2004), which is a decrease in mercury loads of 110 kg/year from existing conditions. Attainment of the objective can be measured two ways: measuring mercury in water and flow in the inputs to the Delta or measuring the concentration of mercury per unit suspended sediment passing the compliance point of Mallard Island and multiplying by the suspended sediment loads. Assuming that long-term average suspended sediment loads do not change, meeting the load allocation requires that the concentration of mercury in suspended sediment exiting the Delta decline to 0.2 mg/kg.

Responsible parties that are assigned total mercury limits to maintain the San Francisco Bay Water Board allocation for the Delta must monitor mercury in their discharge and will be required to report results to the Central Valley Water Board.

As the lead agency, the Central Valley Water Board will need to continue monitoring of total mercury and suspended sediment in water until the load allocation for Delta outflows to the San Francisco Bay has been met. Note that the San Francisco Bay Water Board may change this allocation when it revises the San Francisco Bay Mercury TMDL. The Central Valley Water Board would adjust its total mercury monitoring and control program accordingly.

5.3 Sediment Monitoring

To comply with the proposed requirements for dredging, proponents of dredging projects must monitor concentrations of mercury in sediment. The implementation plan proposes that dredge operations ensure that newly-exposed sediment at each project site has an average total mercury concentration equal to or less than the surface material before dredging. The implementation plan also requires that dredged material with an average total mercury concentration greater than 0.2 mg/kg, dry weight in the fine-grained fraction (less than 63 micron) be protected from erosion. Sieving sediment samples to less than 63 microns and drying them is necessary to be able to evaluate mercury concentrations in a uniform manner.

Staff's proposed amendments to Chapter 5 of the Basin Plan do not contain sediment monitoring requirements for Delta and upstream water bodies. However, evaluating total mercury in sediment may be useful in methylmercury control studies to assess mercury concentrations entering wetlands or other sources of methylmercury. For the methylmercury source characterization and control studies, sediment or soil samples should also be sieved to less than 63 microns and dried for analyses of total mercury.

6 REVIEW OF EXISTING FEDERAL AND STATE LAWS AND STATE & REGIONAL BOARD POLICIES

Any proposed changes to the Regional Water Board Basin Plans must be consistent with existing federal and state laws and adopted State and Regional Water Board policies. Water Code Section 13146 requires that, in carrying out activities that affect water quality, all state agencies, departments, boards and offices comply with state policy for water quality control unless otherwise directed or authorized by statute, in which case they shall indicate to the State Water Board in writing their authority for not complying with such policy. This chapter summarizes existing federal and state laws and policies that are relevant to the proposed water quality objectives and implementation plan described by the proposed Basin Plan amendments.

6.1 Consistency with Federal Laws and Policies

Federal agencies have adopted water quality control policies and plans to which Central Valley Water Board actions must conform. The following federal laws are relevant to the proposed Basin Plan amendments:

- Antidegradation Policy
- Clean Water Act
- Federal & State Endangered Species Acts

These laws and their relevance to the proposed water quality objectives and implementation plan are described in the following sections.

6.1.1 Antidegradation Policy

The federal Antidegradation Policy (from 40 CFR 131.12) states:

> "(a) The State shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy pursuant to this subpart. The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following:
>
> (1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.
>
> (2) Where the quality of the waters exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and

existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.

(3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

(4) In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act."

The proposed Basin Plan amendments would establish the first numeric water quality objectives for methylmercury in the Delta to protect and maintain its beneficial uses. The implementation plan is designed to improve water quality in the Delta and is consistent with this policy.

6.1.2 Clean Water Act

The Clean Water Act requires that numeric criteria be based on "(i) 304(a) Guidance; or (ii) 304(a) Guidance modified to reflect site-specific conditions; or (iii) other scientifically defensible methods" (40 CFR § 131.11 (b) *et seq*.).

Making a change in the current narrative water quality objectives would be consistent with the Clean Water Act. The Central Valley Water Board would need to interpret the existing narrative objectives to adopt TMDLs. Development of a numeric water quality objective would be consistent with the Clean Water Act because states may adopt site-specific numeric water quality standards as necessary to protect designated beneficial uses. Objectives based on the USEPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (USEPA, 2000b) would be consistent with the Clean Water Act because the methodology is part of the 304(a) Guidance.

6.1.3 Federal & State Endangered Species Acts

The federal Endangered Species Act of 1973 was established to identify, protect and recover imperiled species and the ecosystems upon which they depend. It is administered by the Interior Department's U.S. Fish and Wildlife Service (USFWS) and the Commerce Department's National Marine Fisheries Service (NMFS). The USFWS has primary responsibility for terrestrial and freshwater organisms, while the responsibilities of NMFS are mainly marine species such as salmon and whales. In addition, the State of California enacted the California Endangered Species Act (California Fish and Game Code, Sections 2050-2116 *et seq*.), which is administered by the California Department of Fish and Game and similarly maintains State lists of rare, threatened and endangered species. Of the wildlife species in the Delta, bald eagles, California least terns and peregrine falcons are listed as either threatened or endangered species by the State of California or by the USFWS.

The water quality objectives in Alternative 3 are expected to fully protect wildlife species in the Delta. Although the Alternative 3 objective for TL4 fish was developed based on human consumption patterns, the proposed concentration level for this alternative falls below allowable fish tissue concentrations that correlate with safe levels in other sizes and trophic levels of fish that were derived to protect all piscivorous wildlife species (including threatened and endangered species) feeding in the Delta. These

wildlife-specific safe fish tissue concentrations were derived with guidance from the USFWS. To ensure protection of wildlife species that eat small fish, Alternative 3 includes an objective for small TL2 and 3 fish based on safe levels for the least tern. Objectives in Alternatives 4 and 5 are lower than in Alternative 3 and thus provide options that are even more protective of endangered and threatened wildlife species.

The purpose of the proposed Basin Plan amendments is to restore the beneficial uses that are not currently being met, including wildlife habitat. The recommended implementation plan based on Alternative 4 objectives is designed to improve the water quality of the Delta with respect to mercury concentrations and the food supply for wildlife foraging in the Delta. The proposed Basin Plan amendments are not expected to adversely affect endangered species. Indeed, habitat and prey on which piscivorous wildlife species depend are expected to improve as a result of the addition of the proposed water quality objectives and their implementation. Therefore, the proposed Basin Plan amendments are consistent with the federal and state Endangered Species Acts.

6.2 Consistency with State Water Board Policies

The following State Water Board policies[27] are relevant to the proposed Basin Plan amendments:

- Statement of Policy with Respect to Maintaining High Quality of Water in California (Antidegradation Implementation Policy) (Resolution No. 68-16)
- Water Quality Control Policy for the Enclosed Bays and Estuaries of California (Resolution No. 74-43)
- Sources of Drinking Water Policy (Resolution No. 88-63)
- Pollutant Policy Document (Resolution No. 90-67)
- Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304 (Resolution No. 92-49)
- Nonpoint Source Management Plan & the Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (Resolution No. 99-114 and 2004-0030)
- Bay Protection Toxic Hot Spots Cleanup Program (Resolution No. 2004-0002)
- Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (Resolution No. 2005-0019)

These policies and their relevance to the proposed water quality objectives and implementation plan are described in the following sections.

6.2.1 Resolution No. 68-16: Statement of Policy with Respect to Maintaining High Quality of Water in California (Antidegradation Implementation Policy)

State Water Board Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Water in California, includes the following statements:

[27] State Water Board plans and policies are available at: http://www.waterboards.ca.gov/plnspols/index.html

"1. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies.

"2. Any activity which produces or may produce a waste or increase volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained."

Resolution No. 68-16 incorporates the federal anti-degradation standards for surface waters (Section 6.1.1).

The proposed Basin Plan amendments do not specifically authorize any new or existing discharges, and therefore, are not expected to result in any further degradation of Delta waters. The proposed Basin Plan amendments are intended to improve an impaired water body (the Delta) by implementing a program to achieve the proposed water quality objectives through methyl and total mercury source reductions.

6.2.2 Resolution No. 74-43: Water Quality Control Policy for the Enclosed Bays and Estuaries of California

This policy was adopted by the State Water Board in 1974 and provides water quality principles and guidelines for the prevention of water quality degradation in enclosed bays and estuaries to protect the beneficial uses of such waters. The Regional Water Boards must enforce the policy and take actions consistent with its provisions.

The Delta flows into the San Francisco Bay to form the Bay-Delta Estuary. Because improvements in water quality in the Delta will result in improvements in overall Bay-Delta water quality, the actions taken to implement the Basin Plan amendment are also consistent with this policy.

6.2.3 Resolution No. 88-63: Sources of Drinking Water Policy

This policy states that all waters of the state are to be protected as existing or potential sources of municipal and domestic supply water. The proposed Basin Plan amendments are consistent with this policy because they are expected to result in improvements in Delta water quality.

6.2.4 Resolution No. 90-67: Pollutant Policy Document

This State Water Board resolution requires, in part, that the Central Valley and San Francisco Bay Water Boards use the Pollutant Policy Document (PPD) as a guide to update portions of their Basin Plans. The PPD requires that the Central Valley Water Board develop a Mass Emissions Strategy (MES) for limiting loads of mercury, among other pollutants, from entering the Delta. The purpose of the MES is to control the accumulation in sediments and the bioaccumulation of pollutant substances in the tissues of aquatic

organisms in accordance with the statutory requirements of the state Porter-Cologne Water Quality Act and the federal Clean Water Act. The proposed Basin Plan amendments are consistent with this policy and furthers the milestones of the MES by specifically developing and proposing methylmercury fish tissue objectives, an area of concern in the PPD, and by including a monitoring and implementation program to measure reduction and regulate mass emissions of this pollutant.

6.2.5 Resolution No. 92-49: Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304

This resolution contains policies and procedures for the Central Valley Water Board to follow for oversight of cleanup projects to ensure cleanup and abatement activities protect the high quality of surface and groundwater. In order to attain the proposed water quality objective, the proposed Basin Plan amendments provide an implementation plan to reduce methyl and total mercury loading to the Delta and its tributaries. The proposed plan requires that methyl and total mercury discharges from existing and future sources be evaluated and controlled.

6.2.6 Resolution No. 2002-0040: Water Quality Enforcement Policy

The State Water Board adopted the Water Quality Enforcement Policy to ensure enforcement actions are consistent, predictable, and fair. The Policy describes the tools that the State and Regional Water Boards have at their disposal to determine: the type of enforcement order applicable; compliance with enforcement orders by applying methods consistently; and the type of enforcement actions that should be appropriate for each type of violation. The State and Regional Water Boards have authority to take a variety of enforcement actions under the Porter-Cologne Water Quality Control Act. These include administrative permitting authority such waste discharge requirements (WDRs), waivers of WDRs, and Basin Plan prohibitions.

The proposed Basin Plan amendments include implementation provisions that would allow Central Valley Water Board staff to use, where applicable, the enforcement tools provided in the Water Quality Enforcement Policy.

6.2.7 Resolution No. 2004-0002: Bay Protection Toxic Hot Spots Cleanup Program

The State Water Board adopted the Consolidated Toxic Hot Spots Cleanup Plan, which includes cleanup plans for mercury in the Delta. The Cleanup Plan for the Delta requires the development of a phased mercury TMDL program, commencing with Cache Creek in the year 2005. The Cache Creek watershed is a major source of mercury to the Bay-Delta Estuary. The Central Valley Water Board adopted the Cache Creek, Bear Creek and Harley Gulch Basin Plan amendment and TMDL program on 21 October 2005. Development of the Delta TMDL and program of implementation through the proposed Basin Plan amendments further addresses the phased mercury control strategy. State Water Board Resolution 2004-0002 requires the submission of management plans to remedy the mercury impairment in the Delta. The proposed amendments include all of the elements identified in the Cleanup Plan.

6.2.8 Resolution No. 99-114 & Resolution No. 2004-0030: Nonpoint Source Management Plan & the Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program

In December 1999, the State Water Board approved Resolution No 99-114, adopting the Plan for California's Nonpoint Source (NPS) Pollution Control Program (NPS Program) and in May 2004, the State Water Board adopted the Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (Resolution No. 2004-0030). This NPS Implementation and Enforcement Policy explains how State and Regional Water Boards will use their planning, and waste discharge regulation authority under the Porter-Cologne Act to implement and enforce the NPS Program Plan. The Policy for Implementation and Enforcement of the NPS Control Program requires all nonpoint source discharges to be regulated under waste discharge requirements, waivers of waste discharge requirements, a Basin Plan prohibition, or some combination of these administrative tools. This Policy also describes the key elements that must be included in a nonpoint source implementation program.

The proposed Basin Plan amendments do not prescribe specific control actions to reduce nonpoint sources; however, they provide total mercury limits and methylmercury allocations that will guide the development and implementation of control actions. At this time, more information is needed on the factors that control methylmercury production in the Delta and its tributaries before effective management practices for nonpoint sources can be implemented. The proposed Basin Plan amendments provide regulatory requirements by using the Porter-Cologne Water Quality Control Act and other authorities to ensure that parties responsible for those sources obtain this information, evaluate management practices to control methyl and total mercury, and implement technically and economically feasible control actions. The proposed Basin Plan amendments require that the responsible parties complete the characterization and control studies by 2012. At that time the information needed for the development of a methylmercury nonpoint source control program will be available. The Central Valley Water Board will evaluate the studies and feasible management practices and determine whether methylmercury allocations and total mercury limits should be modified and a revised implementation program incorporated into the Basin Plan by 31 December 2014.

6.2.9 Resolution No. 2005-0019: Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California

The Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (a.k.a. State Implementation Plan or SIP) applies to discharges of toxic pollutants into the inland surface waters, enclosed bays, and estuaries of California subject to regulation under the Porter-Cologne Water Quality Control Act and the federal Clean Water Act. Regulation of priority toxic pollutants may occur through the issuance of National Pollutant Discharge Elimination System permits or other relevant regulatory approaches. The goal of the SIP is to establish a standardized approach for permitting discharges of toxic pollutants to non-ocean surface waters in a manner that promotes statewide consistency. The SIP is a tool to be used in conjunction with watershed management approaches and, where appropriate, the development of TMDLs to ensure achievement of water quality standards (i.e., water quality criteria or objectives, and the beneficial uses they are intended to protect). The SIP was effective on 28 April 2000 with respect to the priority pollutant criteria promulgated by the USEPA through the National Toxics Rule and to the priority pollutant objectives established by Regional Water Boards in their Basin Plans. If a water quality objective and a CTR criterion are in effect for the same priority pollutant, the more stringent of the two applies.

The TMDL Report analyzed options to ensure the proposed TMDL implementation program would comply with the CTR. The proposed Basin Plan amendments establish limits and control actions for total mercury that require the reduction of total mercury loading to the Delta, using, as appropriate, the tools and implementation provisions provided in the SIP. These limits are designed to comply with the CTR criterion of 50 ng/l total recoverable mercury in the water column. Therefore, the proposed Basin Plan amendments are consistent with the Policy.

6.3 Central Valley Regional Water Quality Board Policies

The following Central Valley Water Board policies are relevant to the proposed Basin Plan amendments:

- Urban Runoff Policy
- Controllable Factors Policy
- Water Quality Limited Segment Policy
- Antidegradation Implementation Policy
- Application of Water Quality Objectives Policy
- Watershed Policy

These policies and their relevance to the proposed water quality objectives and implementation plan are described in the following sections.

6.3.1 Urban Runoff Policy

On page IV-14.00 of the Basin Plan, the Central Valley Water Board's Urban Runoff Policy states:

> "a. Subregional municipal and industrial plants are required to assess the impact of urban runoff on receiving water quality and consider abatement measures if a problem exists.
>
> "b. Effluent limitations for storm water runoff are to be included in NPDES permits where it results in water quality problems."

The proposed Basin Plan amendments would require Phase I MS4s in the Delta region to conduct methyl and total mercury characterization and control studies and to develop an implementation plan by 31 December 2012 for achieving the proposed methylmercury allocations and maintaining the proposed total mercury limits. The Central Valley Water Board may, upon review of the results of these proposed characterization and control studies, adopt future Basin Plan amendments requiring that Phase I and II MS4s implement methyl and total mercury control actions, to be applied through the NPDES stormwater permits as necessary.

6.3.2 Controllable Factors Policy

On page IV-15.00 of the Basin Plan, the Central Valley Water Board's Controllable Factors Policy states:

> "Controllable water quality factors are not allowed to cause further degradation of water quality in instances where other factors have already resulted in water quality objective being exceeded. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the

waters of the State, that are subject to the authority of the State Water Board or Regional Water Board, and that may be reasonably controlled."

Currently, the proposed water quality objectives for methylmercury in fish are exceeded in the Delta. The proposed Basin Plan amendments are consistent with the Controllable Factors Policy because the Delta methylmercury TMDL and associated program of implementation seek to bring an impaired water body into compliance with the water quality objectives. Potentially controllable sources to, and factors important in net methylmercury production in, the Delta include: WWTP and MS4 discharges; agricultural irrigation runoff; amount and kind of inorganic mercury present in the sediment; amount of permanent or seasonally flooded wetland in a watershed; water rights and salt standards in the Delta; and creation of new water impoundments. The proposed Basin Plan amendments include an implementation plan with actions outlined to (a) control inorganic mercury loading to the Delta and (b) characterize methylmercury sources and evaluate feasible methylmercury controls, so that ultimately methylmercury inputs may be reasonably controlled. No additional discharges are being proposed by, or are expected as a result of, the proposed Basin plan amendments.

6.3.3 Water Quality Limited Segment Policy

On page IV-15.00 of the Basin Plan, the Central Valley Water Board's Water Quality Limited Segment Policy states:

> "Additional treatment beyond minimum federal requirements will be imposed on dischargers to Water Quality Limited Segments. Dischargers will be assigned or allocated a maximum allowable load of critical pollutants so that water quality objectives can be met in the segment."

The proposed Basin Plan amendments establish methylmercury allocations and total mercury limits for dischargers to the Delta waterways, which are included in the CWA Section 303(d) List of Water Quality Limited Segments. Therefore, the proposed Basin Plan amendments are consistent with the implementation of this policy.

6.3.4 Antidegradation Implementation Policy

The Central Valley Water Board's Antidegradation Implementation Policy incorporates State Water Board Resolution No. 68-16 and the federal anti-degradation standards for surface waters (see Sections 6.1.1 and 6.2.1). On pages IV-15.01 and IV-16.00, the Central Valley Water Board's Antidegradation Implementation Policy includes the following statements:

> "… Implementation of this policy [State Water Board Resolution No. 68-16] to prevent or minimize surface and ground water degradation is a high priority for the Board. … The prevention of degradation is, therefore, an important strategy to meet the policy's objectives.
>
> The Regional Water Board will apply 68-16 in considering whether to allow a certain degree of degradation to occur or remain. In conducting this type of analysis, the Regional Water Board will evaluate the nature of any proposed discharge, existing discharge, or material change therein, that could affect the quality of waters within the

region. Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.

Pursuant to this policy, a Report of Waste Discharge, or any other similar technical report required by the Board pursuant to Water Code Section 13267, must include information regarding the nature and extent of the discharge and the potential for the discharge to affect surface or ground water quality in the region. This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives. The extent of information necessary will depend on the specific conditions of the discharge. For example, use of best professional judgment and limited available information may be sufficient to determine that ground or surface water will not be degraded. In addition, the discharger must identify treatment or control measures to be taken to minimize or prevent water quality degradation."

As noted in previous sections, the proposed Basin Plan amendments do not authorize any new or existing discharges and therefore are not expected to result in any further degradation of Delta waters. The proposed amendments include water quality objectives and an implementation plan to improve an impaired water body (the Delta) through methyl and total mercury source reductions. As a result, the proposed amendments are consistent with this Central Valley Water Board policy.

6.3.5 Application of Water Quality Objectives Policy

Excerpts from Policy for Application of Water Quality Objectives are presented below. The full text can be found on page IV-16.00 of the Basin Plan.

"Water quality objectives are defined as 'the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water, or the prevention of nuisance within a specific area.'… Water quality objectives may be stated in either numerical or narrative form. Water quality objectives apply to all waters within a surface or ground water resource for which beneficial uses have been designated…

"The numerical and narrative water quality objectives define the least stringent standards that the Regional Boards will apply to regional waters in order to protect beneficial uses.

"Where compliance with narrative objectives is required, the Regional Board will, on a case-by-case basis, adopt numerical limitations in orders which will implement the narrative objectives."

The numeric water quality objectives in the proposed Basin Plan amendments are specific to surface waters in the Delta and will be used to determine compliance with the narrative objective. The proposed Basin Plan amendments would establish, as necessary, a combination of studies and implementation actions to control the sources of methyl and total mercury (see Chapter 4). Regulatory permits or orders will have appropriate requirements to comply with the implementation plan for the proposed objectives

and time schedules for compliance. The proposed implementation plan will provide a time schedule for the local entities, State, and federal agencies to develop and submit to the Central Valley Water Board plans for methylmercury and total mercury management.

6.3.6 Watershed Policy

On page IV-21.00 of the Basin Plan, the Central Valley Water Board's Watershed Policy states:

> "The Regional Water Board supports implementing a watershed based approach to addressing water quality problems. The State and Regional Water Boards are in the process of developing a proposal for integrating a watershed approach into the Board's programs. The benefits to implementing a watershed based program would include gaining participation of stakeholders and focusing efforts on the most important problems and those sources contributing most significantly to those problems."

The proposed Basin Plan amendments are consistent with the Watershed Policy. Chapter 6 of the TMDL Report includes a source analysis that identified the following methylmercury sources: tributary inflows from upstream watersheds; within-Delta sources such as sediment flux; municipal and industrial wastewater; agricultural drainage; and urban runoff. Approximately 63% of identified methylmercury loading to the Delta comes from tributary inputs while within-Delta sources account for approximately 37% of the load. In contrast, the TMDL source analysis for total mercury (Chapter 7) determined that tributary inputs account for more than 96% of total mercury loading to the Delta. Section 4.4 of this report takes a comprehensive watershed approach to establishing methylmercury allocations and total mercury limits. The adaptive management approach for the implementation program provides the watershed stakeholders and the Central Valley Water Board with an opportunity to better identify sources that contribute most significantly to the impairment and effective technologies and management practices for controlling those sources.

The Central Valley Water Board has conducted and will continue to conduct outreach to the stakeholders in the area encompassed by the proposed Basin Plan amendments. A scoping workshop was conducted in September 2005 and additional meetings with stakeholders are planned before bringing the proposed amendments before the Board members for their consideration. These outreach activities will be conducted to gain participation of stakeholders as part of implementation of the watershed policy. For these reasons, the proposed amendments are consistent with the watershed policy.

6.4 Consistency with Other State and Regional Laws and Policies

As described in the following two sections, the CALFED Bay-Delta Program goals and the Delta Protection Act are also relevant to the proposed Basin Plan amendments.

6.4.1 CALFED Bay-Delta Program

The CALFED Ecosystem Restoration Strategy includes the goal to:

> "Improve and/or maintain water quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed, and eliminate to the extent possible, toxic impacts to aquatic organisms, wildlife and people."

(CALFED Ecosystem Restoration Strategic Goal 6, Attachment 2 ERP Stage 1 IP, August 6, 2001[28])

Because an improvement in Delta water quality should result in an improvement in Bay-Delta Estuary water quality, the proposed Basin Plan amendments are consistent with the above CALFED program goal.

The Record of Decision (ROD) for the CALFED Bay-Delta Program commits the California Bay Delta Authority to restore 30,000 to 45,000 acres of fresh, emergent tidal wetlands in the Delta by 2030 (CALFED Bay-Delta Program, 2000). However, many of the proposed sites are downstream of mercury-enriched watersheds. As described in Chapter 3 of the TMDL Report, extensive restoration efforts in the Delta have the potential to increase methylmercury exposure for people and wildlife.

Requirements proposed in the Basin Plan amendments may initially appear to be in conflict with CALFED's habitat restoration mandates; however, the proposed Basin Plan amendments are consistent with CALFED programmatic water quality goals and further supports the programmatic ROD's CEQA requirements to develop mitigation strategies to address potentially significant adverse environmental impacts. CALFED findings on specific adverse environmental impacts include potential exposure of mercury-laden sediments from activities related to dredging activities; methylation of inorganic mercury to its bioavailable forms from the creation of shallow water habitat in areas that would receive mercury from source water; or release of toxic substances (including methyl and total mercury) into the water column during dredging and construction of CALFED program actions such as levee demolition and disturbances to previously farmed soils. To address potentially significant impacts that may result from CALFED projects, as indicated in CALFED's CEQA documents, CALFED is required to include mitigation measures in the ROD to reduce these impacts to a "less than significant" level (CALFED, 2000, CEQA Findings of Fact, pp. 20-21). The proposed Basin Plan amendments are consistent with the CALFED ROD by providing requirements to study and develop management practices and control actions that would lessen adverse significant impacts resulting from CALFED programmatic projects.

6.4.2 Delta Protection Act of 1992

As described in the Public Resources Code (Sections 21080.22 and 29700-29780), the goals of the Delta Protection Act of 1992 are to:

"(a) Protect, maintain, and, where possible, enhance and restore the overall quality of the delta environment, including, but not limited to, agriculture, wildlife habitat, and recreational activities.

"(b) Assure orderly, balanced conservation and development of delta land resources.

"(c) Improve flood protection by structural and nonstructural means to ensure an increased level of public health and safety."

Section 29735 of the Delta Protection Act established the Delta Protection Commission to administer the Act. The Act directed the Commission to prepare a regional plan for the "heart" (Primary Zone) of the

[28] Available at: http://calwater.ca.gov/Programs/EcosystemRestoration/adobe_pdf/Attachment_2.pdf.

Delta to address key land uses (e.g., agriculture, wildlife habitat and recreation) and resource management for the Delta area. The Primary Zone includes approximately 500,000 acres extending over portions of five counties: Solano, Yolo, Sacramento, San Joaquin and Contra Costa. The Commission adopted its Land Use and Resource Management Plan for the Primary Zone of the Delta (Plan) in February 1995.[29] The policies within this regional plan were adopted as regulations[30] in 2000. The Plan was then forwarded to the five counties traversed by the Primary Zone for incorporation into their General Plans and Zoning codes and implementation in their day-to-day activities. The Delta Protection Commission has appeal authority over local government actions.

Actions taken to implement the proposed Basin Plan amendments would improve the water quality in the Delta and consequently improve the quality of the local fish for consumption by humans and wildlife, resulting in a decrease in the number of fish advisory postings along Delta recreational areas. Decreasing the number of fish advisory postings would increase the recreational opportunities for sport fishing and enhance the local economic productivity associated with increased recreational activities. Hence, implementation of the proposed Basin Plan amendments is consistent with the land use and development goals of the Delta Protection Act.

6.5 Implementation Authority

The State and Central Valley Water Boards have the following regulatory authorities and/or obligations to address the methylmercury impairment in the Delta.

6.5.1 Total Daily Maximum Loads

Section 303(d)(1)(A) of the federal Clean Water Act requires that "Each State shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the Section 303(d) list of impaired waters and to establish a TMDL for those listed waters. Essentially, a TMDL is a planning and management tool intended to identify, quantify, and control the sources of pollution within a given watershed to the extent that water quality objectives are achieved and the beneficial uses of water are fully protected. A TMDL is defined as the sum of the individual waste load allocations to point sources, load allocations to non-point sources and background loading. Loading from all pollutant sources must not exceed the loading (or assimilative) capacity of a water body, including an appropriate margin of safety. The loading (or assimilative) capacity is the amount of pollutant that a water body can receive without violating the applicable water quality objectives.

The specific requirements of a TMDL are described in the United States Code of Federal Regulations (CFR) Title 40, Sections 130.2 and 130.7 (40 CFR § 130.2 and 130.7), and Section 303(d) of the CWA. In California, the authority and responsibility to develop TMDLs rests with the Regional Water Boards. The U.S. Environmental Protection Agency has federal oversight authority for the CWA Section 303(d) program and may approve or disapprove TMDLs developed by the state. If the USEPA disapproves a

[29] The Plan was revised and reprinted in May 2002 and can be accessed on the Commission's web site: www.delta.ca.gov.

[30] See Title 14, California Code of Regulations, Chapter 3). Regulations Governing Land Use and Resources Management in the Delta

TMDL developed by the state, the USEPA is then required to establish a TMDL for the subject water body.

In California, the Porter-Cologne Water Quality Control Act (CWC, Division 7, Water Quality) requires a program of implementation for a TMDL to be included into the Basin Plan (CWC § 13050(j)(3)). This program of implementation must include a description of actions necessary to achieve Basin Plan water quality objectives, a time schedule for specific actions to be taken, and a description of monitoring to determine attainment of objectives.

6.5.2 National Pollutant Discharge Elimination System Permits

The federal Clean Water Act established the National Pollutant Discharge Elimination System (NPDES) to provide a mechanism to regulate point-source waste discharges into surface waters of the United States. In California, the nine Regional Water Quality Control Boards administer the NPDES program. NPDES permits are typically issued to regulate point-source municipal and industrial discharges to surface waters, such as discharges from publicly owned waste water treatment facilities or privately owned facilities that discharge at discrete locations.

6.5.3 Stormwater Permits

The Water Quality Act of 1987 added Section 402(p) to the Clean Water Act (CWA Section 1251-1387). This section requires the USEPA to establish regulations setting forth NPDES requirements for stormwater discharges. Section 402(p) of the CWA provides that an area-wide MS4 permit must "require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the USEPA Administrator or the State determines appropriate for the control of such pollutants." Federal regulations 40 CFR 122.26(d)(2)(iv)(A) and 40 CFR 122.26(d)(2)(iv)(C) also require that MS4 permittees implement a program to monitor and control pollutants in discharges to the municipal system from industrial and commercial facilities that contribute a substantial pollutant load to the MS4. The State of California has in-lieu authority for the NPDES program and the Porter-Cologne Water Quality Control Act authorizes the State Water Board through the Regional Boards to implement this authority.

6.5.4 Prohibition of Discharge and Waste Discharge Requirements

When necessary, the Central Valley Water Board can prohibit certain waste discharges (Water Code § 13243). These prohibitions can apply to types of wastes and/or to specific areas. In addition to prohibitions of waste discharges, pursuant to the Porter-Cologne Water Quality Control Act (Water Code § 13260 *et seq*.) the Central Valley Water Board has the authority to issue individual or general WDRs that govern the amount of pollution that can be discharged to a water body. Any individual or entity discharging waste or proposing to discharge waste in the Central Valley is required to submit a report of waste discharge to the Central Valley Water Board. The Central Valley Water Board may also initiate the permit process by requesting a report of waste discharge from an individual or entity. The Board also has the authority to require dischargers to prepare technical reports providing information related to a discharge and its impacts (Water Code § 13267).

Unlike NPDES permits, WDRs can be applied to waste discharges to land, groundwater, and to nonpoint source discharges to surface waters, including agricultural drainage. WDRs can be issued to parties discharging wastes, including individuals, agencies such as water districts, or companies. WDRs can specify the volume of discharge and set concentration and load limits on the constituents discharged. They can also set receiving water limits. Receiving water limits are the allowable concentration of a pollutant in the receiving water downstream of a discharge. The Central Valley Water Board can require ongoing discharger compliance monitoring as a permit requirement. Where discharge limits in WDRs cannot be met at the time of adoption, the Board adopts a Cease and Desist Order that specifies steps that must be taken and a timeline that must be followed to bring the discharge into compliance. WDRs could have an important role in the implementation of a solution to the methylmercury impairment, as they are the primary regulatory mechanism available to the Board that can be used to address nonpoint source discharges.

6.5.5 Clean Water Act, Section 401 Water Quality Certifications

Under the federal CWA, an applicant for a Section 404 permit from the U.S. Army Corps of Engineers (USACE) for an in-stream activity that may affect water quality also must apply for Water Quality Certification under Section 401 of the CWA. The Section 401 Water Quality Certification is based on the finding that the project will protect beneficial uses, comply with numeric Basin Plan water quality objectives, and uphold the State Water Board antidegradation policy. The proposed Basin Plan amendments include methyl and total mercury requirements for 401 water quality certifications for dredging operations in the Delta.

6.5.6 Requests Pursuant to Porter-Cologne Water Quality Control Act, Section 13267

California Water Code Section 13267(b) provides that:

> "In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waters within its regions, or any citizen or domiciliary, or political agency or entity of the state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge, waste outside of its region that could affect the quality of water within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports."

The Central Valley Water Board has the authority to require dischargers to prepare technical reports providing information related to a discharge and its impacts. A Section 13267 order could be issued to dischargers for the methyl and total mercury source characterization and control studies required by the proposed Basin Plan amendments.

6.5.7 Requests Pursuant to Porter-Cologne Water Quality Control Act, Section 13146

As noted at the beginning of this chapter, Water Code Section 13146 requires that, in carrying out activities that affect water quality, all state agencies, departments, boards and offices must comply with

state policy for water quality control unless otherwise directed or authorized by statute, in which case they shall indicate to the State Water Board in writing their authority for not complying with such policy. Under this policy, state agencies identified in the proposed Basin Plan amendments as responsible for methylmercury source characterization and control studies are required to either conduct the studies or indicate in writing to the State Water Board their authority for not complying with the proposed requirement for the studies.

7 CEQA ENVIRONMENTAL CHECKLIST AND DISCUSSION

The CEQA checklist and discussion will be presented as a separate draft document after management review. It will be made available on the Central Valley Water Board website or by contacting staff. The version of the report that will be released for formal public comments (the public review draft) will contain the CEQA checklist and revisions resulting from the scientific peer reviewers' comments.

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APPENDIX A
SACRAMENTO – SAN JOAQUIN DELTA ESTUARY TMDL FOR METHYLMERCURY
DRAFT STAFF REPORT FOR SCIENTIFIC PEER REVIEW

This report is available on the Central Valley Water Board website:
http://www.waterboards.ca.gov/centralvalley/programs/tmdl/deltahg.html

APPENDIX B
CALCULATIONS FOR WATER QUALITY OBJECTIVE ALTERNATIVES

The calculations used to determine the concentration for each Alternative are presented in order of increasing complexity. Therefore, calculations for Alternatives 3 and 5 are discussed before the discussion of the calculations used to determine Alternative 2 and 4 numerical objectives. No calculations are needed for Alternative 1, which would establish no numeric water quality objective for the Delta.

Calculation of Alternatives for Large Fish

The following equation was used by USEPA for calculation of the recommended fish-tissue based methylmercury water quality criterion (USEPA, 2001). It is the basis of calculation of the TL4 fish objectives in Alternatives 2-5.

Equation 1

$$\frac{\text{(RfD – intake from other sources) * body weight}}{\text{Local fish consumption rate}} = \text{Acceptable level of MeHg in fish}$$

Where: RfD = reference dose for humans, representing the safe, total daily intake of methylmercury (0.1 micrograms MeHg/kg body weight per day).

Intake from other sources = average intake of methylmercury from marine fish by adults in the general population (0.027 micrograms MeHg /kg body weight per day).

Body weight = average, adult human body weight (70 kg)

Alternative 3 assumes people are eating only locally caught TL4 fish and eating the national average commercial fish. Therefore, Equation 1 can be solved as written by inserting the appropriate consumption rate.

For Alternative 3:

$$\frac{(0.10\ \mu g/kg\text{-}day - 0.027\ \mu g/kg\text{-}day) * 70\ kg}{17.5\ g/day\ TL4\ fish} = 0.29\ \mu g/g\ MeHg\ in\ TL4\ fish\ (0.29\ mg/kg)$$

For Alternative 5:

Calculation of this objective also assumes an adult human body weight of 70 kg and a methylmercury reference dose of 0.10 g/kg body weight per day. However, because intake of methylmercury is solely from locally caught Delta TL4 fish and there are no other intake sources (i.e. 0.027 µg/kg-day), the equation used to calculate this alternative water quality objective for the corresponding higher consumption rate appears as:

$$\frac{(0.10\ \mu g/kg\ day) * 70\ kg}{142.4\ g/day\ TL4\ fish} = 0.05\ \mu g/g\ MeHg\ in\ TL4\ fish\ (0.05 mg/kg)$$

For Alternative 2 and 4:

Large fish objectives in Alternatives 2 and 4 assume that people eat combinations of fish from trophic levels 3 and 4 (Alternative 2 also include trophic level 2 fish). Calculation of these objectives required an additional step to determine the concentrations in the various trophic levels. To do this, methylmercury concentrations in the higher trophic levels were put in terms of the concentration in the lowest trophic level. Staff then solved for the lowest trophic level concentration. In order to express the concentration in a higher trophic level, site-specific ratios of methylmercury concentrations between the trophic levels (TLRs) were used. Existing Delta fish concentration data were used to develop the ratios. The TLR between trophic levels 3 and 2 (TLR 3/2) is 4.5. The TLR between trophic levels 4 and 3 (TLR 4/3) is 2.9 (See Table 4.6 in the TMDL Report).

Equation 2 is used to solve the concentrations in various trophic levels:

Equation 2

$$\textbf{Safe fish tissue level in all diet} = (\%\ diet TL_2 * TL2_{conc}) + (\%\ diet TL_3 * TL3_{conc}) + (\%\ diet TL_4 * TL4_{conc})$$

Where: $\%\ diet TL_2$ = percent of TL2 fish in diet

$\%\ diet TL_3$ = percent of TL3 fish in diet

$\%\ diet TL_4$ = percent of TL4 fish in diet

Alternative 2 assumes that people consume fish at rates of: 3.8 g/day of TL2, 8.0 g/day of TL3, and 5.7 g/day of TL4, for a total rate of 17.5 g/day. Using Equation 1 and then Equation 2 to obtain safe fish tissue levels:

$$\frac{(0.10\ \mu g/kg\ day - 0.027\ \mu g/kg\ day) * 70\ kg}{17.5\ g/day\ all\ fish} = 0.29\ \mu g/g\ MeHg,\ average\ in\ all\ fish\ (0.29\ mg/kg)$$

Applying the TL4 and diet percentages and solving for TL2 concentration:

$0.29\ mg/kg = (21.7\% * TL2_{conc}) + (45.7\% * TL2_{conc} * 4.5) + (32.6\% * TL2_{conc} * 4.5 * 2.9)$

$TL2_{conc} = 0.29/(0.21 + (0.45 \cdot 4.5)+(0.33 \cdot 4.5 \cdot 2.9)) = 0.04\ mg/kg$

$TL3_{conc} = 0.04\ mg/kg * 4.5 = 0.20\ mg/kg$ in large, TL3 fish

$TL4_{conc} = 0.04\ mg/kg * 4.5 * 2.9 = 0.58\ mg/kg$ in large, TL4 fish

Alternative 4 assumes that people consume fish at rates of: 16 g/day each of TL3 and TL4, at a total rate of 32 g/day.

$$\frac{(0.10\ \mu g/kg\ day - 0.027\ \mu g/kg\ day) * 70\ kg}{32\ g/day\ TL4\ fish} = 0.16\ \mu g/g\ MeHg\ in\ TL4\ fish\ (0.16\ mg/kg)$$

$0.16\ mg/kg = (50\% * TL3_{conc}) + (50\% * TL3_{conc} * 2.9)$

$TL3_{conc}$ = 0.082 mg/kg in large, TL3 fish

$TL4_{conc}$ = 0.082 mg/kg * 2.9 = 0.24 mg/kg in large, TL4 fish

Calculation for Objective for Small TL2 and TL3 Fish

Water quality objective Alternatives 3 and 4 contain a proposed objective for small trophic level 2 and 3 fish that was developed using Equation 2 and the reference dose, body weight and consumption rate for birds (California least tern) that eat these fish. Wildlife species are assumed to receive all of their methylmercury from the local environment, so the "intake from other sources" is zero.

RfD = reference dose for avian wildlife, representing the safe, total daily intake of methylmercury (21 micrograms MeHg/kg body weight per day).
Body weight = average, female least tern body weight (0.045 kg)
Local fish consumption rate = total ingestion rate of fish less than 50 mm in length from trophic levels 2 and/or 3 (31 g/day)

$$\frac{21\ \mu g/kg\ day * 0.045\ kg}{31\ g/day\ TL\ 2\ \&\ 3\ fish} = 0.03\ \mu g/g\ MeHg\ in\ small,\ TL2\ and\ 3\ fish\ (0.03\ mg/kg)$$

APPENDIX C
COST CONSIDERATION CALCULATIONS FOR PHASE 1 OF THE PROPOSED IMPLEMENTATION PROGRAM

The calculations for the cost estimates will be presented as a separate draft document after management review. It will be made available on the Central Valley Water Board website or by contacting staff. The version of the report that will be released for formal public comments (the public review draft) will contain the cost considerations and revisions resulting from the scientific peer reviewers' comments.